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LEAN ENTERPRISE VALUE PHASE



John T. Shields

**Massachusetts Institute of Technology
Lean Aerospace Initiative, Building 41-205
77 Massachusetts Ave.
Cambridge, MA 02139-4307**

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/s/

JOHN CRABILL
Project Engineer
Manufacturing Research & Development Branch
Manufacturing Technology Directorate

/s/

CHARLES E. WAGNER
Chief
Manufacturing Research & Development Branch
Manufacturing Technology Directorate

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Abstract

The Lean Aerospace Initiative (LAI) is a consortium of U.S. aerospace industry, government, labor and academia. Established in 1993 by a cooperative agreement with the U. S. Air Force ManTech Division, the Massachusetts Institute of Technology constituted a consortium to partner to transform the aerospace industry, reinvigorate the workplace, and reinvest in America using a philosophy called "lean." This report summarizes the second continuing cooperative agreement with the U.S. Air Force.

The Initiative's stated mission is to research, develop, and promulgate practices, tools, and knowledge that enable and accelerate the envisioned transformation of the greater United States aerospace enterprise through people and processes. The Lean Aerospace Initiative is an evolving learning and research community that brings together the key aerospace stakeholders.

LAI accelerates lean deployment through identified best practices, shared communication, common goals, and strategic and implementation tools honed from collaborative experience. LAI also promotes cooperation at all levels and facets of an aerospace enterprise, thus eliminating traditional barriers to improving industry and government teamwork.

The greatest benefits of lean are realized when the operating, technical, business, and administrative units of an aerospace enterprise strive for across the board lean performance, transforming itself into a total lean enterprise. As a consequence, LAI recently concluded the Enterprise Value Phase (Phase IV), which saw it engaged in transforming aerospace entities into total lean enterprises, and delivering value to all stakeholders through research, knowledge and education. This report provides a comprehensive, cumulative, and substantive summary of the progress and significant accomplishments achieved during this phase.

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Summary

The Lean Aerospace Initiative (LAI) consists of government, industry labor and academia organized into a consortium whose purpose is to accelerate the transformation of the greater US aerospace enterprise in the use of lean principles and practices to better deliver value to its stakeholders. LAI provides an action-oriented consortium, where action is fact-based.

The core organizing principle of this “Enterprise Value Phase” reflects the crucial insight set forth in the published book *Lean Enterprise Value*; namely that being lean is not just a matter of elimination of waste, rather becoming lean is a process of eliminating waste with the goal of creating value for enterprise stakeholders. With the knowledge, know-how and tools researched and developed in this phase, the national aerospace enterprise was able to more quickly improve its capability and agility in delivering best lifecycle value.

The Lean Aerospace Initiative was very active during this phase at accomplishing the goals set for the phase as well as addressing numerous opportunities that presented themselves during the progress of the phase. The key activities of the LAI consortium fall into the following categories: governance, transformation, products, knowledge deployment, research and education.

Maintaining the value proposition among all the LAI stakeholders takes dedicated efforts and processes. This is accomplished with an Executive Board and its tactical action group, the Executive Committee (later known as the Steering Council). The phase started with a major focus on assisting the government in its transformation activity. Particular efforts were initiated through a U. S. Air Force program called “Lean Now!” In this program, projects were initiated at the government/industry interfaces in order to reduce waste and add value. This effort was a combined effort of industry and MIT to prototype transformation projects that would be of value to both government and industry. This was an extremely successful LAI consortium effort that resulted in many process improvements, such as \$37M cost savings, 73 percent reductions in a contract closeout process and 50 percent reductions in engine installation times.

Maturing during the phase was also transformation efforts at the enterprise level. In the process of testing LAI’s new tool, the Enterprise Value Stream Mapping and Analysis methodology, four enterprise transformation efforts were facilitated using LAI industry and academia resources. The enterprise activities engaged were: the C-17 Program Enterprise consisting of the government System Program Office, the Boeing C-17 Program Office and the Defense Contract Management Agency in-plant representatives; the Ogden Air Logistics Center, the Oklahoma Air Logistics Center; and the Robins Air Logistics Center.

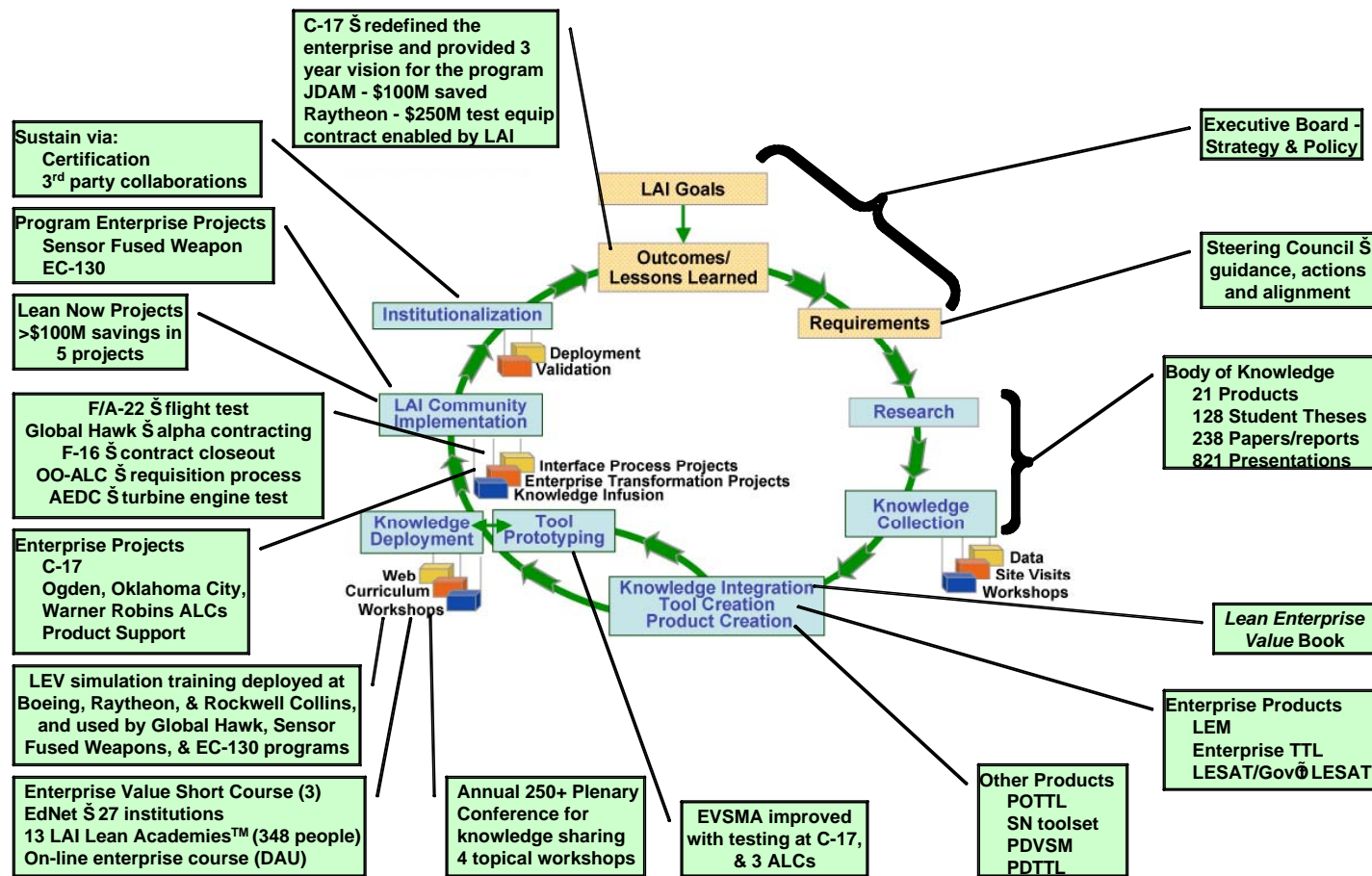
During this phase a number of products reached maturity. These include the Enterprise Value Stream Mapping and Analysis Methodology, Product Development Value Stream Mapping, Supplier Networks Transformation Toolset, Government Lean Enterprise Self Assessment Tool, the Lean Enterprise Value Simulation Game, the Lean Enterprise Value Short Course, the LAI Lean Academy™ curriculum, the forty-hour subject matter expert (SME) facilitator course and the SME one-hour training course.

LAI is a large learning community. Knowledge sharing occurred at the annual Plenary Conference in which members shared experiences, networked among themselves and learned by interaction with research activities. Knowledge was also shared in workshops, team meetings and telephone calls throughout the phase. On a continuous basis, the LAI web site (lean.mit.edu) is the primary means to convey the accumulated LAI knowledge to LAI members and for certain knowledge elements, the public.

The research in this phase addressed three main questions: how to architect/design future lean enterprises, how to accelerate lean enterprise transformation and how to build evolving and adapting enterprises? LAI research was conducted in three main focus areas: Product Lifecycle, Enterprise Architecture, and Enterprise Change. The efforts during the phase resulted in reports, theses, case studies and white papers. More importantly, the accumulated knowledge was shared with the consortium, incorporated into LAI products and often tested in implementation activities.

The Massachusetts Institute of Technology (MIT) undertakes sponsored research projects such as the LAI with the understanding that: research is integral to the educational experience of both faculty and students, research findings contribute to the world's knowledge base, and MIT's efforts have an impact on issues and problems that are central to the advancement of society. In this regard there are three important ways LAI contributes to the knowledge base: research support, education of future enterprise leaders and extension of the curriculum to other educational institutions. The LAI consortium effort served as a model program for bringing academia together with industry, government and labor in a dynamic and interactive consortium. The LAI consortium serves as an innovative model for research projects addressing important societal issues of the 21st Century. Of particular note was the formation of the LAI Educational Network (EdNet) which is a group of universities and colleges working together with LAI industry and government members to develop and deploy curriculum based on lean and Six Sigma research and practical knowledge.

There are many ways that LAI delivers value to its members. Broadly value was delivered to all the LAI stakeholders via assistance with transformation projects, development of products and tools, developing lean knowledge in an enterprise context through research, sharing knowledge with the LAI membership, and establishing the means in which the knowledge is broadly disseminated through education. Using the LAI Knowledge/Learning Cycle, some examples of this value are shown in **Figure 1**.



Acronym Key:

AEDC – Arnold Engineering Development Center

EdNet – Educational Network

LEM – Lean Enterprise Model

OO-ALC – Ogden Air Logistics Center

Mapping

POTTL – Production Operations Transition to Lean

ALC – Air Logistics Center

EVSMA – Enterprise Value Stream Mapping and Analysis

LESAT – Lean Enterprise Self Assessment Tool

PD TTL – Product Development Transition to Lean

SN – Supplier Networks

DAU – Defense Acquisition University

JDAM – Joint Direct Attack Munition

LEV – Lean Enterprise Value

PDVSM – Product Development Value Stream

TTL – Transition to Lean

Figure 1: LAI Knowledge/Learning Cycle Value

Introduction

In the Lean Enterprise Value Phase (Phase IV) the Lean Aerospace Initiative (LAI) Consortium continues to accelerate the transformation of the greater US aerospace enterprise in the use of lean principles and practices to better deliver value to its stakeholders. LAI provides an action-oriented consortium, where action is fact-based.

The core organizing principle of this new “Enterprise Value Phase” reflects the crucial insight set forth in the published book *Lean Enterprise Value*; namely that being lean is not just a matter of elimination of waste, rather becoming lean is a process of eliminating waste with the goal of creating value for enterprise stakeholders. With the knowledge, know-how and tools researched and developed in this phase, the national aerospace enterprise was able to more quickly improve its capability and agility in delivering best lifecycle value.

Aerospace leaders concluded that not only must aerospace make the “Lean Enterprise” transformation it must also end up with a culture permanently embracing the new behaviors embodying Enterprise Value. At the same time industry must be equipped with agile management and processes, broadly skilled people, and nimble government-industry-labor partnerships in taking fact-based calculated risks to adjust to rapidly changing market conditions.

These ideas form LAI’s guiding vision for the future state of aerospace:

Vision: US aerospace enterprises reliably and efficiently creating value and rapidly adapting to change

Achieving this national vision for aerospace is a transformation that requires new ways of thinking and acting. Improvements have to be made to many thousands of processes and organizational relationships used by aerospace companies, government agencies and units of organized labor and other components of the greater US Aerospace Enterprise. The *mission* of the LAI carves out the Consortium’s contribution to making that aerospace transformation happen. Accordingly, the consortium developed this mission to deliver all its stakeholders:

Mission: Research, develop and promulgate knowledge, principles, practices, and tools to enable and accelerate the envisioned transformation of the greater US aerospace enterprise through people and processes

While the LAI beneficially involves military and non-military companies and government agencies, its genesis and central core remained oriented toward the defense aerospace industry. That is reflected in our team:

Mission Team: US Military Service organizations, government agencies, military and commercial Aerospace Industry, Organized Labor, and Academia

Industry members of the Consortium were, with the support of the LAI, making significant progress in implementing lean principles and practices in production operations. In this phase the LAI sought to do for the rest of the enterprise what it did for manufacturing. The LAI, with

its industry-government-labor stakeholders, took action to apply their experience in support of the OSD and Services transformation efforts. The plan was fact based by research into lean knowledge, principles and practices and development of lean tools supporting stakeholder transformation. Government transformation initially focused on processes at the interface between government and industry. Later entire enterprise transformations were undertaken.

It is now clear that applying lean principles and practices to create value is a permanent part of the US industrial landscape. Nevertheless, many workers and managers in industry and government are unfamiliar with the basic concepts of lean. A goal of this phase of the LAI was to develop educational materials on lean principles and practices for use by its stakeholders and for teaching in universities. This resulted in the creation of the LAI Educational Network.

A fundamental principle of enterprise value is “Deliver value only after identifying stakeholder value and constructing robust value propositions.” Planning for the LAI Enterprise Value Phase followed that principle by understanding the needs of our stakeholders, members of the LAI Consortium, and translating those values into goals for the Enterprise Value Phase. Six goals were identified:

Goal 1: Support the on-going lean transformation of industry.

Goal 2: Enable lean value-creating supplier base

Goal 3: Support lean transformation of the government

Goal 4: Educate and train stakeholders in value-creating lean principles and practices

Goal 5: Improve effectiveness of organizations and all the employees across the total enterprise

Goal 6: Support member lean implementation efforts by sustaining tools and knowledge base and by sponsoring outreach events.

There were five corresponding efforts or classes of products in conjunction with the goals above that guided efforts during the phase. These actions are as follows:

1. Industry members of the LAI have invested heavily in implementing lean principles and practices in aerospace manufacturing. While there is much yet to be done, industry was now more interested in implementing lean principles and practices in other parts of its enterprises. Consequently, LAI members sought substantial value from research and tools that would help extend lean practices to the total enterprise.
2. While major aerospace companies are expending substantial energy on implementation of lean practices, many smaller suppliers, representing a substantial fraction of the value added of aerospace products, are relatively untouched by the lean revolution. Although LAI cannot possibly address the multitude of suppliers directly, it did engage the transformation of the aerospace supplier base by working with federal and state programs, including the Manufacturing Extension Partnership. There also was continuing work to help define the lean practices of supplier network management.
3. LAI stakeholders valued a central effort to help the government apply lean principles and practices. The LAI delivered significant value working with government agencies and industry to help facilitate transformation activities in areas such as: (a) removal of

contracting, accounting and acquisition policy barriers to contractors becoming lean, (b) usage of government-industry business processes to encourage lean behavior and (c) management of relevant change in both military and non-military government agencies.

4. LAI stakeholders placed high value on developing lean curricula and bringing that knowledge to the educational institutions that provide employees for LAI members.
5. The membership is clearly intent on preserving its investment in lean knowledge and tools. Sustaining and updating the LAI tools and Web site were essential continuing functions of the LAI. Direct outreach had a priority as high as indirect dissemination of knowledge and tools. Members saw workshops, conferences and executive forums as delivering significant value to the Consortium.

Progress and Significant Accomplishments

The Lean Aerospace Initiative was very active during this phase at accomplishing the goals set for the phase as well as addressing numerous opportunities that presented themselves during the progress of the phase. In the sections below the highlights of the progress and accomplishments will be addressed. This by no means depicts the level of activity that was necessary to bring about these significant accomplishments. Appendix A provides a summary of most but not all LAI activities giving a much better understanding of the entire consortium engagement to bring about transformation in the aerospace community.

The key activities of the LAI consortium fall into the following categories: governance, transformation, products, knowledge deployment, research and education. These categories will be used to report the key events, progress and accomplishments of the Lean Aerospace Initiative.

Governance

Maintaining the value proposition among all the LAI stakeholders takes dedicated efforts and processes. The LAI Executive Board was responsible for developing the policy for the consortium. This board had Co-Chairs from each of the major stakeholders: government, industry, and academia. Value delivery to the LAI members was facilitated by a subgroup of the Executive Board, first called the Executive Committee and later the Steering Council. Each member had a representative to the Network of Champions who served as the point of contact between the member and LAI. Additionally there was a subgroup formed to address the LAI Business Model, called the Strategic Business Model Team.

There were five Executive Board meetings, fifteen Executive Committee meetings or telephone conferences, six Steering Council meetings or telephone conferences, seven Strategic Business Model Team meetings or telephone conferences, and twenty-nine Network of Champions meetings or telephone conferences. These efforts were successful at guiding the consortium and allowing it to progress in its mission and accomplish much.

Transformation

The phase started with a major focus on assisting the government in its transformation activity. Particular efforts were initiated through a U. S. Air Force program called “Lean Now!” In this program, projects were initiated at the government/industry interfaces in order to reduce waste and add value. This effort was a combined effort of industry and MIT to prototype transformation projects that would be of value to both government and industry. In this process industry members donated Subject Matter Experts (SMEs) to assist with the conduct of these projects and mentor the projects to a successful conclusion. This effort was truly unique and demonstrated the flexibility, initiative and determination of the LAI members to foster lean principles and practices in the greater US aerospace enterprise.

The “Lean Now” projects were:

- Combined Test Force (F-22)

- Alpha Contracting (Global Hawk)
- Contract Closeout (F-16)
- Turbine Engine Test (Arnold Engineering Development Center)
- Procurement Request (Ogden Air Logistics Center)
- Aircraft overhaul (Compass Call, EC-130)

This was an extremely successful LAI consortium effort that resulted in many process improvements. Some of these improvements were a reduction by more than half the time it takes to load flight software, more than a 37 percent reduction in contracting processes, a \$37M cost savings on the integrated software suite of the Global Hawk, a 73 percent reduction in the audit process of contract closeout, engine installation time cut by 50 percent, and condition assessment time of incoming aircraft improved by more than 40 percent. But, in the end, perhaps the greatest benefit was realized by the people that were exposed to the “Lean Now” transformation process itself. There were multiple additional improvement spirals without LAI consortium assistance as these newly developed lean experts took the knowledge gained to improve other aspects of their organizations.

Maturing during the phase was also transformation efforts at the enterprise level. In the process of testing LAI’s new tool, the Enterprise Value Stream Mapping and Analysis methodology, three enterprise transformation efforts were facilitated using LAI industry and academia resources. The enterprise activities engaged were: the C-17 Program Enterprise consisting of the government System Program Office, the Boeing C-17 Program Office and the Defense Contract Management Agency in-plant representatives; the Ogden Air Logistics Center; the Oklahoma Air Logistics Center; and the Robins Air Logistics Center. In many ways this was pioneering activity. Never before had LAI ventured into full enterprise level transformation assistance. The learning, tool improvement and enterprise assistance was truly remarkable. It resulted in the refinement and development of a new, valuable tool for enterprise transformation.

It is difficult to measure the improvements of these enterprise level efforts since many of the benefits are from the interactions of functions, people or processes within the enterprise. However, this process based approach contributed to a 47 percent reduction in time to process proposals in the C-17 program as one manifestation of improved processes.

Products

During this phase a number of products reached maturity. These include the Enterprise Value Stream Mapping and Analysis Methodology, Product Development Value Stream Mapping, Supplier Networks Transformation Toolset, Government Lean Enterprise Self Assessment Tool, the Lean Enterprise Value Simulation Game, the Lean Enterprise Value Short Course, the LAI Lean AcademyTM curriculum, the forty-hour subject matter expert (SME) facilitator course and the Lean Introduction one-day training course. See Figure 3 at the end of the section to understand how these products fit into the LAI product family. Each of these completed products is available on the LAI web site (lean.mit.edu). Some of these products are also interactive on the web.

Enterprise Value Stream Mapping and Analysis Methodology (Version 1.0)

The Enterprise Value Stream Mapping and Analysis (EVSMA) methodology serves as an integrated framework for diagnosing and improving overall enterprise performance, by identifying enterprise-level waste and enhancing the value delivery to each enterprise stakeholder. The objective of applying EVSMA methodology is to optimize the enterprise value stream as a critical element in formulating the strategic business plan and transforming to a lean enterprise.

EVSMA methodology provides enterprise executives with a management tool that will help them:

- Identify barriers to the creation/delivery of value to each stakeholder;
- Specify a vision of the future lean enterprise;
- Determine significant gaps between current and future states; and
- Prioritize opportunities for eliminating waste and increasing value creation/delivery for the maximum benefit of the total enterprise

The primary benefits and distinguishing features of EVSMA methodology are that it:

- Focuses at the total enterprise level, on enterprise-wide processes, rather than within individual functions, programs, or tasks;
- Provides a cohesive methodology for diagnosing an enterprise to expose sources of waste and to identify impediments/barriers to value delivery among functions and processes;
- Gives consideration to the needs/values of all stakeholders;
- Provides an analysis to connect stakeholder values, strategic objectives, enterprise processes, and metrics;
- Identifies process interfaces, disconnects and delays;
- Provides a structure for creating a shared vision for the enterprise; and
- Identifies improvement opportunities that will benefit the entire enterprise

Product Development Value Stream Mapping (PDVSM) Manual

The Product Development Value Stream Mapping (PDVSM) Manual is a fact-based, action-oriented tool for transforming off-the-factory-floor processes. The PDVSM is based on years of LAI research in lean product development. Academic research and member experience and best practices are used to translate, adapt, and expand value stream mapping concepts to the unique needs of the product development processes. Depth is provided where necessary, and notes and references provide source material and justifications for the material. The PDVSM is NOT, however, an academic monograph--it is a practical guide to the application of value stream methods to product development processes. Chapters cover all the necessary steps.

- Why and how lean applies to product development
- Getting started: identifying stakeholders, forming the team, bounding the problem, and identifying the value desired
- Mapping: practical advice on mapping tasks and information flows, collecting and interpreting process data; assessing value creation
- Waste Identification: finding the seven "info-wastes"

- Improving the process: best practices for quick improvements and creating and implementing the future state.
- Beyond the future state: guidance for profound transformation towards the ideal state.

Throughout, mapping best practices, practical examples and metrics are called out in special tables or sub-sections for easy identification and use.

The PDVSM is synergistic with other LAI tools such as the Transition to Lean Roadmap (PDVSM helps you focus on the value stream); Enterprise Value Stream Mapping (PSVSM gives you a tool for non-factory streams); and the Lean Enterprise Value training seminars (the seminars provide a quick experience in mapping, while PDVSM provides depth and reference materials).

Supplier Networks Transformation Toolset (Version 1.0)

Supplier Networks Transformation Toolset (Version 1.0), developed by LAI's Supplier Networks Working Group, was announced on March 22, 2004. The toolset was developed in response to a strong "pull" from the LAI consortium member organizations, reflecting the important need that developing a lean supplier base is a critical enabler of achieving enhanced competitive advantage (through significantly lower costs, higher quality and reduced cycle time), resulting in greater value creation for multiple enterprise stakeholders. The toolset consists of two elements: a transition roadmap tool and a supplier management self-assessment tool.

Government Lean Enterprise Self Assessment Tool (GLESAT)

The GLESAT was developed from the Enterprise Self Assessment Tool (LESAT). As with the LESAT, this tool is for self-assessing the present state of "leanness" of an enterprise and its readiness to change. The GLESAT is 60-70 percent similar to the LESAT. The primary differences are in terminology making the wording more appropriate for use in government settings. All of the concepts from the original LESAT were retained. The GLESAT is focused on government program offices and government organizations with multiple functions needed to fulfill their mission.

Lean Enterprise Value Simulation (Version 1.6)

The Lean Enterprise Value (LEV) simulation (or "game") is a unique tool for demonstrating the value and challenges of implementing lean principles and practices at the enterprise level. It currently comprises four modular simulations developed on a foundation of insights gained through more than 11 years of LAI intensive research and consortium real-world experience. It is a complete, flexible simulation of a complex enterprise, which allows interactive, hands-on lessons in lean improvement.

Participants fabricate parts, process engineering design jobs, assemble, and support a fleet of Lego™ aircraft (see Figure 2), to satisfy customer and corporate demands. Each participant is in charge of a facility: an assembly plant, subcontractor fabricating plant, product development department, or service and support depot. A sophisticated economic system allows participants to

track their performance and justify their decisions as they progress on their lean enterprise journey. During the course of the simulation, participants learn advanced lessons in applying lean at the enterprise level, quantifying the value of lean improvements, and managing change in a complex, interdependent enterprise.

The LEV simulation is, intrinsically, a tool for teaching enterprise-level lean thinking. It includes manufacturing, a supplier network, engineering, and service and support areas that must work together to achieve enterprise performance. Even within the individual modules of the simulation, participants must identify not only how to improve the mechanical aspects of their processes, but also the more complex challenge of how to interact with elements of the enterprise outside their control, on mechanical, financial, and human levels.

The LEV simulation is designed around teaching a few high-level lessons. The details of a simulation-based training experience can be modified to further emphasize these lessons as desired. Examples include (but are not limited to):

- Change management processes
- Economics of lean transformation
- Communication and teamwork during both operations and transformations
- Enterprise value stream mapping and analysis (EVSMA)

All of these subjects are at least touched on intrinsically in the simulation. This learning can be greatly accentuated by formal teaching and exercises integrated into a training experience.

The LEV simulation has demonstrated that it provides a very effective practice field for a variety of lean skills and tools. Addition of formal teaching and exercises, and in some cases minor modifications to the simulation itself, can greatly increase the value of this hands-on experience.

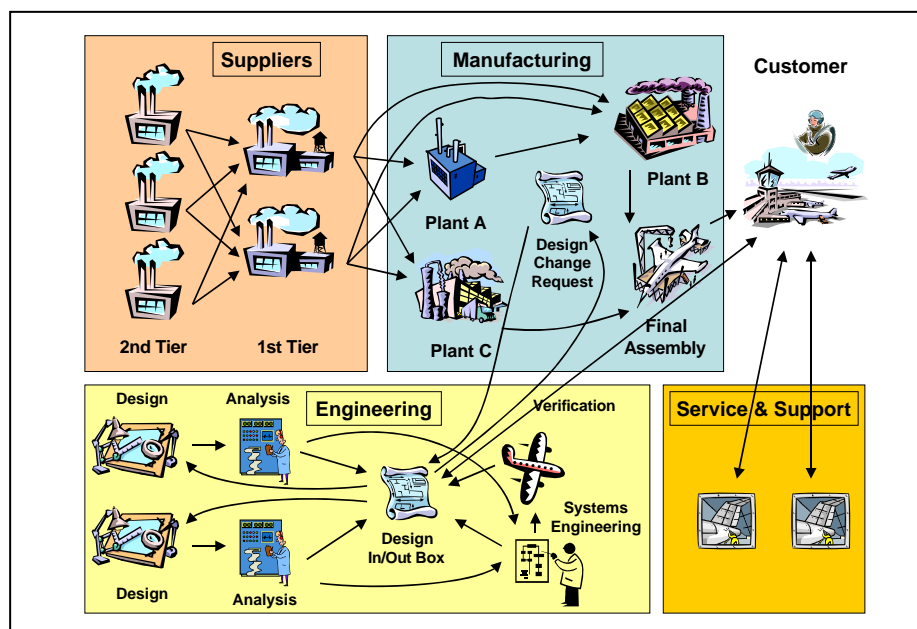


Figure 2: Lean Enterprise Value Simulation

Lean Enterprise Value Short Course

At the heart of course is the full Lean Enterprise Value Simulation is used throughout a 2.5 day Lean Enterprise Value seminar. The focus is on the intrinsic ability of the simulation to illustrate lean enterprise concepts, and on the big lessons of change management, economics of lean, teamwork, and EVSMA. These lessons are reinforced by exercises and lecture material. Basic lean tools (5S, Kanban, etc.) are reinforced and used as tools for the simulation through short exercises.

During the Short Course, participants manage the evolution of an enterprise from a poorly-performing legacy operating state to a high-performance integrated lean enterprise. Their enterprise consists of ten suppliers, two manufacturing/ assembly organizations with four facilities each, and an engineering organization. Early on, participants learn how to apply a variety of basic lean principles to stabilize, standardize, and control their processes to improve local performance.

They use value stream mapping and capacity, gap, and root cause analyses to identify opportunities for improvement, and use that information to develop business cases for lean improvement plans. They also gain a deeper understanding of the dynamics of change as they introduce improvements into legacy processes.

As an integrated enterprise, participants experience enterprise interdependencies first-hand and the challenges they present to lean transformation. They learn how to approach value stream mapping in a dynamic, integrated enterprise. Enterprise-level communication, coordination, and transition planning skills add an extra dimension to the lean transformation challenge. The event culminates with all elements of the simulated enterprise coming together to create a lean solution that quadruples enterprise throughput relative to the legacy state. More importantly, levels of communication, coordination, and shared identity and responsibility increase dramatically over the period of the course. The concluding discussion centers on the participants' potential roles as change agents in their own enterprise transformation projects, and how LAI tools and products that are open and available to all LAI members can help them.

The LEV Short Course is offered on a periodic basis by LAI to teach lean enterprise principles through an active learning process. The simulation and materials used in the course have been adapted and used to assist enterprise transformation activities in the LAI consortium, such as in Lean Now! projects. Additionally, several LAI members have adopted the simulation and materials for use in their own internal lean training programs.

LAI Lean Academy™ Curriculum

The LAI Lean Academy™ is a one-week course that provides a hands-on introduction to lean fundamentals. It is targeted towards undergraduate students, and is taught at the point of use during an internship, co-op, or new hire assignment.

The LAI Lean Academy™ also serves as a platform to advance the capability of university

faculty to teach lean, develop lean curriculum, stimulate the diffusion of lean principles into on-campus coursework, and build partnerships between industry and academia. The courses are collaboratively facilitated instructors from industry and universities. Out of this experience emerge new hires, cooperative students, and summer interns, each ready to practice lean in a variety of disciplines and roles.

Subject Matter Expert (SME) 40 hour Facilitator Course

Based on the experience of the “Lean Now” effort a course was developed to train project facilitators. The LAI consortium brought together materials from members (primarily industry and MIT) which was determined to be the “best of the best.” These materials were packaged by the LAI at MIT team for use in training facilitators prior to project engagements at “Lean Now” activities. The five-day course consists of presentation materials covering subjects such as basic lean concepts, team building, facilitator skills, value stream mapping, various tools, sustaining change, and project management.

Lean Introduction One-Day Training Course

Again based on the experience from the “Lean Now” efforts a one-day course was developed to introduce the lean change process to perspective organizations. This is a key presentation to motivate and engage people in order to start a transformation event.

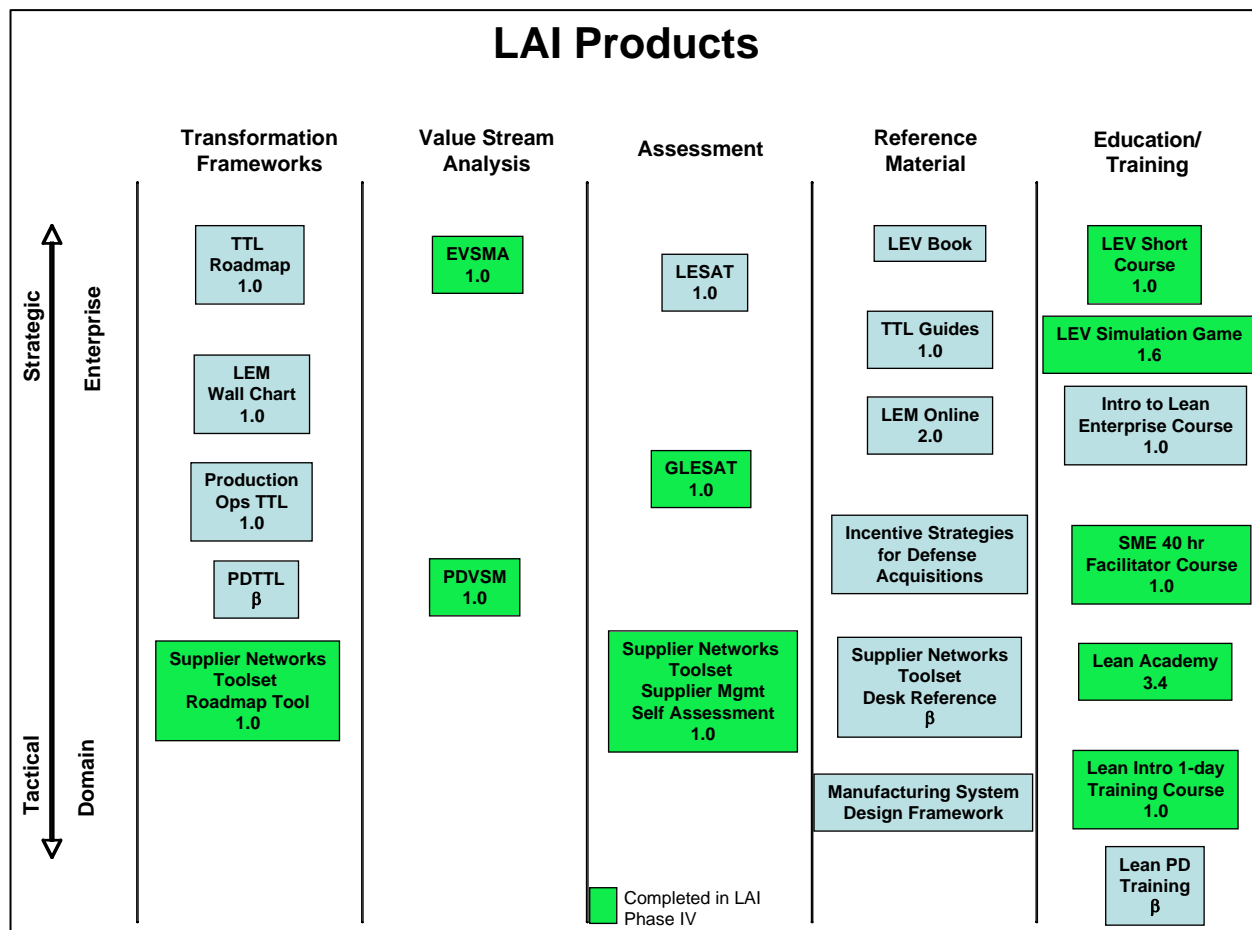


Figure 3 : LAI Product Set with indicated Products completed in LAI Phase IV

Knowledge Deployment

LAI is a large learning community. The primary method for knowledge sharing was an annual Plenary Conference in which members shared knowledge, networked among themselves and learned by interaction with research activities. Knowledge was also shared in workshops, team meetings and telephone calls throughout the phase. On a continuous basis, the LAI web site (lean.mit.edu) is the primary means to convey the accumulated LAI knowledge to LAI members and for certain knowledge elements, the public.

Plenary Conferences

2003: Transformation Across Enterprise Boundaries

Government Enterprise Transformation

Keynoting the 2003 annual LAI Plenary Conference, General Lester Lyles, Commander of the Air Force Materiel Command (AFMC), talked about the acquisition community transformation in the current operational and acquisition environment while expressing the opportunities for the

LAI Consortium. Transformation is demanded in this new environment from “business” as usual to agile acquisition, “heavy” force structure to rapidly deployable and sustainable force structure, meeting program specs to horizontally integrating capability, center/program focus to an enterprise mindset and values, top-down initiatives to front line innovations. The goals of the AFMC enterprise is to improve warfighter partnership, rapidly meet operational needs, deliver effects-based capabilities, promote horizontal integration, enhance interoperability and commonality, maintain viable capability (for aging systems), and capitalize on divestiture opportunities. On this latter goal, one critical element is to eliminate non-essential work. AFMC is engaged in a number of activities to improve internal processes. Success will lead to tackling the big issues and we must have the resolve to sustain a steady process of improvements committed for the long haul. This is where the Lean Aerospace Initiative can help us focus. By emphasizing value creation and with the assistance of LAI industry members, we can jointly identify non-essential tasks.

The operational environment has changed – we are an expeditionary aerospace force now. This demands effects-based capability that delivers capabilities to the warfighter where integrating multiple weapons systems is the key. In this environment information dominates. Information has to be seamless to the warfighters and integrated within their capabilities, yet it also has to be flexible and responsive to the changing threat environment. This requires teamwork between acquisition and operational forces where agile acquisition is key to providing needed capabilities.

To acquire what is needed by our expeditionary forces requires a faster, smaller, leaner acquisition workforce that can match the needs of the expeditionary mindset and culture. The acquisition community needs to be able to adapt quickly to new challenges and uncertain circumstances. This will demand revolutionary capabilities particularly as the challenges of military deployment, workforce reductions and technology change continue. In AFMC, the intent is to emulate the expeditionary mindset and culture; be innovative, adaptive and responsive; be easy to do business with; and be effective and efficient in operation.

The Lean Aerospace Initiative is evolving to help in this effort. LAI is no longer just an “academic” exercise; it now provides hands-on government, industry, academia teamwork. This has been exemplified in the three prototype Lean Now programs: F/A-22, F-16 and Global Hawk. Each has seen impressive results that have focused on value creation. The Lean Now process is relevant for all programs and additional projects are being nominated. This effort enables Air Force acquisition to meet today’s challenges. More importantly it fosters and strengthens teamwork relationships: government with industry, process with policy and procedures, “shop floor” with “boardroom” and programs supporting integrated solutions. The way ahead is to institutionalize Lean Now concepts and practices at the working level through training and socialization; at the management level through mentoring, selling and listening; at the executive level through leading communicating vision, unify concurrent activities and setting policy. LAI enables this team to focus on value creation.

Industry Enterprise Transformation

Partnering with General Lyles at the 2003 LAI Plenary Conference, Dan Burnham, Chairman and Chief Executive Officer of Raytheon Company, gave his perspectives on enterprise transformation. Deviating widely from his prepared script, Dan talked about driven people and

what it took to get other people “pumped.” He reminisced about leadership training from the uniformed services and emphasized the real transformation going on in the military. Thinking about the end state desired, he mentioned that he was influenced by Bob Galvin’s talk about 6-sigma. He had mused – why can’t we be perfect, why can’t he convert these ideas to agility, speed and passion? Therefore, he became an agent for change recognizing the need for fundamental change to address changes in the threat, technology and limited resources.

The Raytheon experience parallels other transformations. It is not predictable, there will be bumps in the road, and it is driven by the burning platform but guided by a vision. Dan talked about what he called the “last supper” before the consolidation decision where the complexities of mergers and acquisitions, layoffs and consolidation, perturbations in program management would all impact the company. He then talked about what had to be put in place to support the change:

- Senior executives, line management and the whole organization of one mind
- Regular meetings
- Realization that through 6-sigma and lean we can be perfect
- A vision
- Goals, often displayed on large cards
- A common language (this is where 6-sigma helped)
- Stretch goals
- Employee emersion
- Constant repetition

He talked about three plans: strategic plan, annual operation, and human resource review process. He talked about change – not so much a problem on the front line or at senior executives, but certainly so for middle management. He talked about their four year effort where things like working capital turns, inventory turns, payment of debt and improvement in contract performance. He talked about building 6-sigma change agents --1100 black belts and 1400 green belts, involving customers into his training. In fact, he mentioned that some of his best advocates came from his customers because they realized that 6-sigma saved lives.

On reflection about the transformation he said they had to envision the end state. They started at the enterprise. They asked “What are the CEO facts and figures to support this effort?” They recognized the values that were needed: satisfy the customer; speed, agility and empowerment; integrity; be seen as one company; and communicate, communicate, communicate. It was hard to get the story between the layers, however. There is a lot of attenuation of the message worsened by the number of layers. They collected data as their feedback mechanism. Data from the lowest levels (over 4 years) – 92% state company is a good place to work and from their customers – 97% satisfied customers. They tested whether everyone knew what the company was about and why. In execution, they sought predictable processes, good practices (IPDS, EVMS, CMM, CMMI and risk management), workforce planning, and questioned at what cost. One measure of success was that their contract win rate improved.

Thinking about going forward, what does it take to go to the next level? Dan thought that it took customers as knowledgeable as we are, suppliers that join the journey, and public recognition. Transformation is hard. This mindset has to be reset - everyone else needs to change not us. It is

stressful; however, the risk of not changing is more stressful because it may mean failure. Continuous learning is a necessity – must instill an eagerness to learn. They emulated techniques used in the military – reading lists for example. Technology can be applied to change but it is just starting in the IT field. More effective is giving employees goals and releasing them from the bureaucracy. You must get the middle management to be part of the change. Construct the effort so that it is fun but timing is critical. Surround yourself with talent and improve your HR processes. Integrated HR processes from GE are an example: appraisals, training system, flow of talent, getting rid of non-performers. People are tribal by nature. Success comes when it is fun, safe, solutions based on data and cooperation. Dan also thought that there should be a public sharing of transformation scores.

2004: Lean Enterprise Transformation: Making It Happen

The conference sought to explore the enterprise transformation challenges facing the consortium. In the first days' general session Prof. Deborah Nightingale convened the conference by sharing with the attendees the LAI consortium's role in enterprise transformation by reviewing efforts ongoing from all consortium stakeholders in the past year. Prof. Nightingale stated that the LAI consortium offered a unique capability for addressing enterprise transformation through (1) engaged members assisting transformation efforts; (2) knowledge areas addressing the key issues and challenges facing enterprises; (3) knowledge teams with communities of practice, tool development and research to leverage consortium knowledge; (4) integrated enterprise toolset to guide transformation efforts; and (5) education to make a an impact teaching lean concepts nationally.

Keynote speakers from the Army, Navy and Air Force shared their thoughts on transformation efforts on-going in their services. Maj Gen N. Ross Thompson of the US Army representing Gen Kern talked about the transformation efforts being lead by the US Army in general and the US Army Materiel Command (AMC) in particular with information about their enterprise excellence progress and plans. Maj Gen Thompson stressed an evolving culture of innovation which sought continuous measurable improvement. The AMC has been on an enterprise excellence evolution since 2002 which has embraced lean thinking. Their thinking is based on the soldier and ground systems as an integrated system life cycle focusing on value streams. They have and are using lean concepts to remove waste and increase efficiency in these value streams. AMC had success stories in manufacturing and service areas of which he highlighted Picatinny where there was a \$2.2B estimated savings to date and armor protection kits for Army vehicles where quick response allowed design to delivery in 4 months and funding to delivery in 7 weeks.

Dr. Thaddeus H. Sandford from Boeing Integrated Defense Systems (IDS) talked about their enterprise transformation following various consolidations and the integration of numerous initiatives into common themes. Dr. Sandford related that IDS approached their transformation with process-based initiatives. The key initiatives were in systems engineering, best practices and lean. These efforts contributed in the C-17 and Aerospace Support winning the Malcolm Baldrige Award.

Rear Admiral Michael C. Bachmann talked about Naval Aviation's transformation initiative, AirSpeed as a means to focus value to the warfighter using lean, six sigma and theory of constraint tools to enable cost-wise readiness across the naval aviation enterprise. Rear Admiral Bachmann explained that metrics were unreliable with limited predictability in parts requirements resulting in near-term solutions where a full readiness integrated improvement was needed. With a focus on cost as well as readiness, AirSpeed was initiated as a Naval enterprise approach. Using multiple tools the effort seeks to create a culture of continuous process improvement under the notion of cost-wise readiness. With several examples, Rear Admiral Bachmann explained some outcomes, particularly at NAS North Island and MALS 26 where parts readiness, issue effectiveness, delivery times and aircraft availability numbers were improved significantly.

Representing Gen Martin, Dr. J. Daniel Stewart talked about past accomplishments at the US Air Force Materiel Command and the future direction of their transformation and restructuring efforts. Dr. Stewart talked about the three-step transformation process: organization, governance and processes. The organizational change was influenced by both top-down and bottom-up influences focusing on five pillars: developing, fielding, engineering, sustaining and business process transformation. The processes were broken into governing processes, mission processes and enabling processes. In much of this effort lean concepts were being applied.

On the second day of the conference, an executive panel session was convened where Maj Gen Kevin J. Sullivan from the Ogden Air Logistics Center, Lisa Kohl from Northrop Grumman Space Technology, Thomas A. Pinski from the International Association of Machinists and Aerospace Workers, Christopher B. Cool from Northrop Grumman, and Col William A. Guinn from the Letterkenny Army Depot each talked about their enterprise transformation efforts. At the conclusion of this session each shared their top lessons learned while undergoing their enterprise transformation.

2005: Lean Enterprise Transformation: Building the Infrastructure

A record attendance of more than 250 people was set, with LAI members and other attendees from industry and government, from as far away as South Korea, gathered at the Laguna Cliffs Marriott in Dana Point, California for two days of networking and learning. Keynote speaker Bob Conner, executive director of AFMC, captured the essence of the Conference's theme - Enterprise Transformation: Building the Infrastructure - in his discussion of the transformation of the AFMC when he said, "It's tough to transform without changing." Mr. Conner went on to explain how the AFMC had changed. Most notable of which is their orientation to the warfighter with organizational elements of wings, groups and squadrons.

Organizational design choices in lean transformation were explored in a panel session with William Kessler, Lockheed Martin; John Kirkgasser, Pratt & Whitney; Robert Patterson, Raytheon; and Charles Touns, Boeing. Each spoke candidly about their company's choices and challenges in lean transformation.

In breakout sessions the general session, Conference attendees learned about the elements necessary for a successful transformation from people who had been there and done that. They

shared their practical experiences and research findings from the perspectives of government programs, industry and academia. The keys, they all agreed, were shared language and definitions; trustful relationships and connecting people to the process; focusing on valued results and equitable incentives; leadership support and participation; in-house expertise (Jan Klein's "insider outsiders"); and cultures that support openness and teamwork.

The overall take away from the 2005 Plenary Conference can best be summarized by the four challenges that Dr. Carroll identified as key outcomes from the Conference.

- Challenge 1: take action with partial planning - spiral development of lean thinking
- Challenge 2: standardize tasks and processes, but in ways that encourage innovation - lean is a verb...a way of thinking, not just tools
- Challenge 3: definition of the enterprise is crucial, but difficult - it is more about value and stakeholder relationships than about control
- Challenge 4: patience is essential - the business case is ultimately based on faith (the measures and numbers come later)

LAI Web Site

The primary means of delivering knowledge to the consortium was through the LAI web site (lean.mit.edu). The LAI web site consists of sections that cover news about LAI, information about LAI, LAI event calendar, LAI Communities, The LAI Educational Network, the LAI Lean Academy™, “Lean Now,” LAI products, LAI publications, LAI research and forums. In addition the web site is the primary means of conveying other knowledge deployment events such as the annual Plenary Conference, Executive Board Meetings, and other governance meetings. The site has both a public and member only capability. The general rules for the division between the content are as follows:

Products: All LAI products that reach version 1.0 are made publicly available (product only) in a .pdf format. Any description materials, facilitation manuals, presentation materials or any other supporting items are available to LAI members only. These additional materials may be in either a pdf or native format depending on their use. Any draft products or development versions of products (alpha, beta, etc.) will be available to LAI members only in the format determined by the product developer.

Research: LAI theses are made available publicly (thesis only) in pdf format. The thesis executive summary and presentation (if available) will be made available only to LAI members in both pdf and native formats. Generally a conference paper or journal article, if published, will be made publicly available in pdf format. Student research plans and posters can also be made available in native formats to members only

Meetings: There are a number of meetings. There are Executive Board Meetings, Steering Council Meetings, Team Meetings, and perhaps others. Generally this content is only available to LAI members.

Plenary Conference: The Plenary Conference agenda and presentations are available to the public.

After redesigning the LAI web site for greater access, visibility and expanded capabilities, the following statistics were gathered over an 8-month period:

- Average site visit time over all visitors is 11 minutes, 09 seconds. This is in contrast to the web norm of less than three minutes for a single site.
- The top 10 identifiable visitors (classed by domain) are: 1) U.S. Air Force; 2) Boeing (IDS); 3) U.S. Army; 4) Northrop Grumman; 5) Lockheed Martin; 6) Textron; 7) Pratt & Whitney; 8) Raytheon; 9) MIT; and 10) (tie) Microsoft, University of Southern California.
- Average number of unique (first-time) visitors: on a daily basis - 293; on a weekly basis - 1,550; on a monthly (30-day) basis: 7,052; extrapolated over a 12-month period - 91,676.
- Total number of (all) visitors, 1,650,000
- Top 10 most visited pages: 1) Research; 2) Products; 3) Communities; 4) LAI Lean Academy; 5) About LAI; 6) Lean Now!; 7) Education Network - EdNet; 8) Our Book; 9) Lean Enterprise Value (LEV) Simulation; 10) Lean Enterprise Self Assessment Tool (LESAT).
- Most popular pages: Research (26%), Products (23%), Communities (particularly Lean Academy and EdNet, which together account for almost 20%).
- Web site visit sources: LAI members 31%, non-LAI members 69% (of which 11% were international visits)

Research

LAI research was conducted in three main focus areas: Product Lifecycle, Enterprise Architecture, and Enterprise Change. These focus areas were distinctly different from the research organization of the previous phase and illustrated the consortium's desire to investigate what lean entailed at the enterprise level. There were three main questions: how to architect/design future lean enterprises, how to accelerate lean enterprise transformation and how to build evolving and adapting enterprises? The efforts during the phase resulted in reports, theses, case studies and white papers which are cataloged below. Each of these is available on the LAI web site (lean.mit.edu).

Reports

Space System Architecture Final Report of SSPARC
2004 September 01; Dr. Hugh McManus

Summary of Research Conducted by the Manufacturing Systems Team 1994-2002
2004 July 13; Timothy Gutowski and J. Thomas Shields, co-leads, MIT (paper compiled by Amanda F. Vaughn / J. Thomas Shields)

An Assessment of the Degree of Implementation of the Lean Aerospace Initiative Principles and Practices within the US Aerospace and Defense Industry
2004 February 13; Thomas E. Shaw and Alexander Lengyel, GEIA; Greg Ferre, MIT

Applying the Lessons of “Lean Now” to Transform the US Aerospace Enterprise: A Study Guide for Government Lean Transformation
2003 August 22; Ron Jobo, USAF

A Proposal for Enterprise Value Phase of the Lean Aerospace Initiative
2002 October 31; CTPID staff

Lean Transition of Emerging Industrial Capability (LeanTEC)
2002 March 28; E. Shroyer, Boeing

A Holistic Approach to Manufacturing System Design in the Defense Aerospace Industry
2002 March 13; Amanda F. Vaughn and J. Thomas Shields, MIT

Theses

Lifecycle Perspectives on Product Data Management
2005 September 01; Erisa K. Hines

Value Stream Mapping and Earned Value Management: Two Perspectives on Value in Product Development
2005 September 01; Ryan Whitaker

Approaches to Crisis Prevention in Lean Product Development by High Performance Teams and Through Risk Management
2005 September 01; Josef Oehman

Designing the Lean Enterprise Performance Measurement System
2005 August 17; Vikram Mahidhar

United States Air Force Air Logistics Centers: Lean Enterprise Transformation and Associated Capabilities
2005 August 12; Jessica L. Cohen

Improving Complex Enterprises with System Models
2005 June 30; Justin Hemann

The Role of SCADA in Developing a Lean Enterprise for Municipal Wastewater Operations
2005 May 06; Stanley J. Prutz

Development of a Process for Continuous Creation of Lean Value in Product Development Organizations
2005 May 06; Jin Kato

A Multi-Attribute Value Assessment Method for the Early Product Development Phase with Application to the Business Airplane Industry
2005 February 01; Troy D. Downen

An Analysis of Retention Issues of Scientists, Engineers, and Program Managers in the US Air Force

2005 February 01; Derek W. Beck, USAF

Information and Communication in Lean Product Development

2005 January 01; Martin Graebisch

Learning Strategies and Performance in Organizational Teams

2004 November 01; P. Henrik M. Bresman

Lean Product Development: Making Waste Transparent

2004 August 19; Christoph Bauch

IT Management in the Aerospace Industry

2004 May 17; Gregoire Ferre

Modularity as an Enabler for Evolutionary Acquisition

2004 May 14; Nirav B. Shah

The Dell Operating Model

2004 May 10; Blaine Paxton

Developing a Circumstance-Based Innovation Strategy for a Midsized Aerospace Manufacturer: Fostering Intrapreneurship, Opening Boundaries, and Seeding Disruption

2004 May 07; Michael M. Brylawski

Enterprise Level Value Stream Mapping and Analysis for Aircraft Carrier Components

2004 May 07; Yuliya M. Frenkel

ACE vs. Six Sigma

2004 May 07; Thomas C. Hutton

Driving a Lean Transformation Using a Six Sigma Improvement Process

2004 May 07; Satish Krishnan

Enterprise Design for Dynamic Complexity: Architecting and Engineering Organizations Using System and Structural Dynamics

2004 May 07; Theodore F. Piepenbrock

A Study of the Mighty Motors Operating System: Making Sustainable Improvements at a Powertrain Manufacturing Facility

2004 May 06; Gregory David Dibb

Process for Evaluating Options for Materials Management Outsourcing

2004 May 04; Mark Hagan

The Application of Value Stream Management Principles In a Batch Production Environment

2004 March 08; Daniel J. Allison

Measuring and Managing Intellectual Capital in the U.S. Aerospace Industry

2003 September 15; Lawrence R. Siegel

Product Development Strategies in Evolutionary Acquisition

2003 August 22; Bobak Ferdowsi

The Integrated Concurrent Enterprise

2003 August 13; David B. Stagny

Institutionalizing Change in Aerospace Process and Product Settings

2003 July 15; Sandra Jo Kassin-Deardorff

Product Development Processes and Their Importance to Organizational Capabilities

2003 June 16; Bing Liu

Lean Enterprise Distribution Tactics with Customer Supply Chain Integration

2003 June 09; Eric A. White

Multi-Attribute Tradespace Exploration and its Application to Evolutionary Acquisition

2003 May 23; Jason Edward Derleth

*Multi-Attribute Tradespace Exploration with Concurrent Design as a Value-Centric Framework
for Space System Architecture and Design*

2003 May 23; Adam M. Ross

Architecting Evolutionary Strategies Using Spiral Development for Space Based Radar

2003 May 20; Christopher James Roberts

*Lean Enterprise Self-Assessment as a Leading Indicator for Accelerating Transformation in the
Aerospace Industry*

2003 May 16; Cory R. A. Hallam

*Tools for Evolutionary Acquisition: A Study of Multi-Attribute Tradespace Exploration (Mate)
Applied to the Space Based Radar (SBR)*

2003 May 09; II Lieut. Timothy J. Spaulding, USAF

*Stakeholder Collaboration in Air Force Acquisition: Adaptive Design Using System
Representations*

2003 May 02; Robert E. Dare

Lean Enterprise Integration: A New Framework for Small Businesses

2003 April 14; Thomas A. Seitz

Stakeholder Analysis in the Context of the Lean Enterprise

2003 March 09; Ignacio Grossi

Improving the Management of System Development to Produce More Affordable Military Avionics Systems

2003 February 16; Jeremy P. Tondreault

Strategies for Dealing with Instabilities in a Complex, Multi-Project Product Development System Engineering Environment

2003 February 14; Michael R. Wright

Conference Papers

Value-Based System of System Development

2005-09-28; Eric Rebentisch, MIT

Conference presentation presented at the AIAA Infotech Conference, 28 September 2005

IT Enabled Enterprise Transformation: Perspectives Using Product Data Management

2005-07-08; Erisa K. Hines and Jayakanth Srinivasan, MIT

IT Enabled Enterprise Transformation: Perspectives Using Product Data Management

Lean Engineering: Doing the Right Thing Right

2005-06-27; Hugh McManus, Metis Design/MIT

Conference paper presented at the First International Conference on Innovation and Integration in Aerospace Sciences, 4-5 August 2005, Queen's University Belfast, Northern Ireland, UK

Using Stakeholder Value Analysis to Build Exploration Sustainability

2005-01-17; Eric S. Rebentisch, LAI

Delivered at the American Institute of Aeronautics and Astronautics Conference (2004)

Note: There are other conference papers that were delivered but the copyright was retained by the conference.

Case Studies

Lean Enterprise Change at Warner Robins ALC

2005 May 28; George Roth, MIT

Warner Robins and the Buy Purchase Request Process

2005 May 10; Jessica Cohen

Lean at the C-5 Galaxy Depot: Essential Elements of Success

2005 May 10; Betty Barrett and Lydia Fraile, MIT

The Paveway™ Program Transformation
2005 March 23; Justin Hemann

Raytheon Paveway™ – Lean Enterprise Change
2005 March 23; George Roth

Lean Change at a Crossroads: C-130 Depot Maintenance at Warner Robins ALC
2005 February 28; John Dickmann

Strategies for Workforce Flexibility and Capability: The New Job Families at Boeing St. Louis
2004 August 18; Barrett, Betty; Cutcher-Gershenfeld, Joel; Fraile, Lydia; and Litwin, Adam

Investing in Knowledge, Skills, and Future Capability in an Uncertain Business Environment
2003 March 12; Rockwell Collins and IBEW Locals 1362 and 1634

White Papers

Lean Supply Chain Now Concept Demonstration Initiative (draft)
2005-08-26; Supplier Networks Working Group, LAI

Preliminary Observations on Program Instability
2003-10-01; Eric Rebentisch, MIT

Education

The Massachusetts Institute of Technology (MIT) undertook sponsored research projects such as the LAI with the understanding that: research was integral to the educational experience of both faculty and students, research findings contributed to the world's knowledge base, and MIT's efforts had an impact on issues and problems that are central to the advancement of society. In this regard there were three important ways LAI contributed to the knowledge base: research support, education of future enterprise leaders and extension of the curriculum to other educational institutions. The LAI consortium effort served as a model program for bringing academia together with industry, government and labor in a dynamic and interactive consortium. The LAI consortium served as an innovative model for research projects addressing important societal issues of the 21st Century.

Research Support

The Lean Enterprise Value Phase (Phase IV) involved funding for ten faculty, seven research staff and twenty completing student research assistants. Many other faculty and students were involved through collaborative efforts funded by other sources. The research contributed directly to the development of two new curriculum courses at MIT: Integrating the Lean Enterprise and Enterprise Architecting. These efforts contributed to the enduring knowledge base and had a significant impact on implementation of lean practices in the aerospace industry and government agencies.

Education of Future Enterprise Leaders

Perhaps, in the long run, the greatest product from LAI will be the people with lean knowledge that have been educated and placed in the aerospace work environment. Illustrative of that goal find the first jobs of the LAI supported students from this phase below in Table 1.

Table 1: LAI Student First Job after Graduation from MIT

LAI Student Name	Grad Date	1 st Job Company	Location	Position
1Lt Tim Spaulding	Jun-03	U. S. Air Force	Sheppard AFB, Wichita Falls, TX	Student Pilot
Lt. Col. Rob Dare	Jun-03	USAF	ESC, Hanscom AFB, MA	ESC/AE
Jason Derleth	Jun-03	Jet Propulsion Laboratory California Inst. of Technology	Pasadena, CA	Space Systems Engineer
Cory Hallam	Jun-03	Northrop Grumman Integrated Systems	St. Augustine, FL	Advanced Enterprise
Bing Liu	Jun-03			
Nirav Shah	Jun-03	Continuing at MIT – PhD		
Adam Ross	Jun-03	Continuing at MIT - PhD		
Maj. Ron Jobo	Aug-03	USAF	ASC, Wright-Patterson	Global Hawk SPO
Bobak Ferdowsi	Aug-03	JPL	Pasadena, CA	Systems Engineer
Sandra Kassin-Deardorf	Aug-03	Draper Lab	Cambridge, MA	Systems Engineer
Dave Stagny	Aug-03	Moog, Inc. Aircraft Group	East Aurora, NY	Value Stream Improvement Leader
Maj Dennis Deitner	Aug-04	USAF	Scott AFB, IL	AFMC Cmdr's Rep
Gregoire Ferre	Dec-04	Renault SA		Corporate and Strategic Planning
Troy Downen	Feb-05	Raytheon Aircraft Company	Wichita, KS	Senior Engineer, New Product Development
Henrik Bresman	Feb-05	Continuing involvement with MIT		
Justin Hemann	Jun-05	TBD		
Ryan Whitaker	Aug-05	Boeing Satellite Systems	El Segundo CA	Engineer/Scientist 2
Jessica Cohen	Aug-05	IBM Business Consulting	Boston, MA	
Erisa Hines	Aug-05	TBD		
Vikram Mahidhar	Aug-05	Deloitte	Boston, MA	Research Consultant

Educational Network (EdNet)

The LAI Educational Network (EdNet) is a group of universities and colleges working together with LAI industry and government members to develop and deploy curriculum based on lean and Six Sigma research and practical knowledge. Formed in 2002, the EdNet currently includes more than 27 member schools who have signed the EdNet No-Cost Collaborative Agreement. The LAI EdNet was formed among institutions of higher education with two specific objectives: to support continuous learning throughout the US aerospace enterprise by sharing knowledge and curriculum, and to develop and deploy curriculum that teaches lean principles at key universities, businesses and military institutions. The vision of EdNet is to provide more opportunities for the growing community of its members to communicate and collaborate in a variety of ways, especially among member schools and with LAI members, in support of its overarching goal of the transformation of the US aerospace industry.

EdNet activities included the following:

- Collaborating to expand the incorporation of lean principles into engineering and business curriculum
- Developing improved educational modules to be inserted into existing curriculum
- Facilitating LAI Lean Academy™ courses

Most notable of the above was the success achieved in the LAI Lean Academy™. Faculty from EdNet schools, together with LAI members, developed and offered a week-long LAI Lean Academy™ course to more than 300 students and 30 instructors. The EdNet had several events each year, including an annual meeting to share knowledge and best practices and an LAI Lean Academy™ for instructors.

EdNet membership is open to all accredited institutions of higher learning whose graduates enter LAI member organizations. Membership in the LAI EdNet also entitled members to access many key lean research documents and findings authored by LAI itself. An institution can become a member free of charge, simply by signing the No Cost Collaborative Agreement.

Conclusion

During this 31 month Cooperative Agreement the Lean Aerospace Initiative delivered value to all the LAI stakeholders via assistance with transformation projects, development of products and tools, developing lean knowledge in an enterprise context through research, sharing knowledge with the LAI membership, and establishing the means in which the knowledge is broadly disseminated through education.

The LAI has contributed a great deal of value to its membership over this period some of which is summarized below:

- Conducted over 22 major “Lean Now” transformation support activities on projects at the intersection between government and industry resulting in highly published improvements in seven different projects
- Conducted over 12 major and numerous coordination efforts in support of enterprise transformation efforts with the Enterprise Value Stream Mapping and Analysis (EVSMA) Methodology resulting in establishing enterprise value streams, their objectives and their envisioned future state for five ever increasingly larger enterprises
- Successfully developed the Enterprise Value Stream Mapping and Analysis (EVSMA) Methodology through the active engagement in prototyping, alpha, beta and version 1.0 versions with four government and one industry enterprise
- Engaged and used the Product Development Value Stream Mapping (PDVSM) with members as an integral part of their value stream mapping efforts on complex product development environments often coupled with other LAI tools to ensure a useful and actionable output from the effort
- Completed the Supplier Networks Transformation Toolset as an LAI working group activity encompassing a transition roadmap and supplier management self assessment tool to help improve the management of complex supplier networks
- Increased the application of the LAI Lean Enterprise Self Assessment Tool (LESAT) to be more applicable to the government setting with the development of the Government Lean Enterprise Self Assessment Tool (GLESAT)
- Through multiple iterations and improvements, matured the Lean Enterprise Value Simulation, first born to convey the knowledge from the LAI book, *Lean Enterprise Value* through an interactive game that simulates an entire enterprise, making it a flexible product that was incorporated into three member training programs and used in multiple events to initiate major improvement events
- Refined the Lean Enterprise Value Short Course as the premiere course to educate members in the value of a lean enterprise
- Established the LAI Lean AcademyTM curriculum and process to deliver hands-on fundamental knowledge targeted at undergraduate, interns and new hires
- Developed a facilitator course to train transformation facilitators to be successful leaders of enterprise transformation efforts
- Developed a training course to engage transformation leadership teams in a transformation process
- Conducted three annual Plenary Conferences with 250 nominal participants each to share lean enterprise knowledge as part of a greater learning community

- Created a world class web site to capture the 12 years of knowledge generated by the LAI
- Created seven research reports detailing knowledge gained from LAI research efforts
- Sponsored 40 theses research projects to develop knowledge on lean concepts and applications that provide the building blocks of lean enterprise knowledge
- Conducted 8 case studies to understand lean activities and improve our knowledge of its application
- Developed lean ideas and concepts through two working papers
- Developed two MIT courses on lean enterprise concepts
- Graduated 20 students of which four were employed into aerospace associated government jobs, four into aerospace industry associated jobs, five into related aerospace jobs, and three continued at MIT further contributing to lean enterprise knowledge
- Formed the LAI Educational Network as an association between LAI members and 25 educational institutions with its legal agreements and organizational structure
- Conducted 10 LAI Lean AcademyTM offerings resulting in over 300 members educated and 30 instructors qualified to teach portions of the course
- LAI community knowledge sharing is represented in the estimated in-kind contributions of \$5.2M from industry members and \$1.9M from government members

LAI provided the forum where members were assisted in their thinking about how to develop the value framework with their stakeholders. LAI offered a thoughtful process (value identification, development of the value proposition, and delivery of value) that worked in other large, complex enterprise settings, and provided a knowledge community to help the enterprise realize its strategy. In addition, LAI developed a number of enterprise tools that assisted the entire enterprise or segments of it in developing or sustaining a lean transformation. When used in conjunction with the enterprise's strategy, these tools provided guidance and insight throughout the process of its lean transformation.

To support all levels of the enterprise, LAI's knowledge network shared lean lessons learned, discovered new ideas in the lean journey, provided a means to involve members of the organization, and materials to assist the greater organization understand what lean means and did this for the entire enterprise (not just manufacturing). The LAI knowledge network is based on more than a decade of research involving benchmarking, in-depth case studies, and application-based research. This knowledge has often been integrated into specific tools or products, knowledge sharing workshops, policy recommendations, formal presentations and curriculum.

Much of the thinking was captured in LAI's award-winning book *Lean Enterprise Value*. LAI represents a combination of fact-based research, practical tools for implementation of complex enterprise transformation, and knowledge diffusion efforts, such as its annual Plenary Conference, and the Educational Network, which shared knowledge and curriculum with LAI members and their closely linked educational institutions.

Finally, LAI offers the only forum that pulls together many of the stakeholders needed by any U.S. aerospace enterprise to really have a chance at making system level changes. Recent implementation projects focused at improving processes at the interface between government and industry (called Lean Now efforts) is but the tip of this iceberg as the consortium addresses full enterprise level transformations.

Appendix A: LAI Events

1. Governance:

Co-Chair

Meetings

1 Apr 03: LAI Meeting with Bill Kessler, Cambridge MA

2 Dec 04: LAI Co-Chairs Dinner, Boston MA

Executive Boards

21-22 May 03: Executive Board Meeting, Arlington, VA

The Executive Board met on May 21 and 22, 2003 at the Hilton Crystal City in Arlington, VA. On May 21st, General Lyles joined the meeting and heard progress, plans and issues relative to the Lean Now activities associated with LAI's goal of government transformation. There were also discussions on LAI goals associated with industry and supplier base transformation. Sustaining the LAI tools and knowledge was also discussed with a focus on recent tool developments and the recent Plenary Conference as examples of knowledge deployment. At the dinner, Dick Lewis talked about the LAI Educational Network. He introduced the pilot Lean Academy process being piloted at Rolls Royce for summer interns with the assistance of MIT and Purdue. On May 22nd the morning meeting convened with a recap of the previous day's events and then presentations on LAI goals on education and training, and employee and organizational transformation. Featured during the first goal presentation was a report on results from the study of Lean Enterprise Self-Assessment Tool results. This study indicated the positive relationship between leadership maturity and the maturity of other life cycle or enabling process maturity as well as the successful management transformation efforts. The meeting adjourned at noon. Later in the afternoon, the Industry Co-Chair, Bill Kessler, briefed Blaise Durante, the government Co-Chair, who was out of town until after the conclusion of the meeting. Most of the presentation material is already posted on the LAI Web Site

10-11 Dec 03: Executive Board Meeting, Arlington, VA

The LAI Executive Board met for a social hour and dinner on December 10, 2003 then a morning meeting on December 11, 2003. At the social hour, LAI inaugurated the display of 8 posters about LAI emerging products, Lean Now results, and LAI research. At the dinner, General Martin, the Commander of the Air Force Materiel Command and LAI Co-Chair, spoke and presented recognition plaques to the Lean Now Subject Matter Experts (SMEs). Please see SME Recognition item below.

The next day the four LAI Co-Chairs, Gen Martin (AFMC/CC), Mr. Blaise Durante (SAF/AQ), Prof Sheila Widnall (MIT) and Dr Bill Kessler (Lockheed Martin), opened the meeting by giving their strategic views of future challenges facing LAI. Specifically, the

initial portion of the meeting was focused on an issue that surfaced three days earlier during a meeting among the co-chairs as to what role LAI could play in enabling Air Force Acquisition to reduce/eliminate costly impacts to complex system programs/products due to ineffective and faulty systems engineering principles/processes by systems integrators. Hence, one part of the board meeting was focused on discussing and defining this challenge.

After a discussion period the second portion of the board meeting focused on LAI results in 2003, system of measures for transformation, LAI transformation enablers, improving effectiveness of organizations and LAI's strategic imperatives for 2004. Presentations from the Executive Board are on the LAI web site under the Presentations tab. The meeting notes will be distributed to the Executive Board members and the Network of Champions by Noel Nightingale, LAI's Executive Director.

19-20 May 04: Executive Board Meeting, Boston, MA

The LAI Executive Board met in Boston on the evening of May 19th for a social/LAI research poster session, dinner and talk by Sheila Widnall on the Columbia Accident Investigation and Its Findings. As Sheila noted the report is about 1/3 technical and 2/3 cultural with many of the latter findings applicable to the complex systems of systems issues the LAI members face.

The board meeting on May 20th consisted of three sections: the LAI strategic challenge, a report on the LAI Education Network (EdNet) and the status of the Systems Engineering Revitalization effort. The morning session on the LAI Strategic Challenge addressed the success of Lean Now, the applicability and value of LAI Enterprise tools, and a growing list of enterprise level transformation engagements. Ken Percell of the Air Force Materiel Command's Transformation Office, talked about the reorganization of his office and how its restructuring will assist in transformation of not only the Air Force Materiel Command (AFMC) but Air Force processes. He also saw further engagement with LAI on a broader enterprise perspective of the entire AFMC. This level of activity is taxing the consortium resources and was a matter of serious discussion. The board recommended that the already established strategy team and business model team accelerate their efforts to provide recommendations to the board as soon as possible.

The EdNet presentation updated the board on EdNet accomplishments, the Lean Academy offerings this summer and the Lean Systems Engineering Working Group activities. A new activity to foster engagement of faculty members at EdNet institutions by establishing a EdNet Faculty Fellows program enlisted interest by the board members so that the effort will continue.

Marty Evans and Donna Rhodes talked about the Systems Engineering Revitalization effort that LAI accepted as an action item to assist the USAF at the last Executive Board Meeting. There has been significant progress and a plan has been approved which includes looking at past research, a workshop in June and a number of longer term activities focused on policy, a guidebook and best practices.

The presentations for this meeting are posted on the LAI web site.

8-9 Dec 04: Executive Board Meeting, Cambridge, MA

The board met on December 9, 2004 in Cambridge, MA. The meeting was focused on whether to approve two major recommendations proposed by the LAI Executive Committee to resolve issues confronting the consortium: to extend the LAI Consortium for 5 years, and to implement the recommendations of the Strategic Business Model Team. The board voted without dissent in favor of both recommendations. The agenda of the meeting revolved around value delivered to LAI stakeholders in four imperatives: facilitate enterprise transformations, expand lean enterprise knowledge, foster a learning community within the total aerospace enterprise and sustain the LAI consortium. Presenters from all stakeholder groups expressed the value they received from their participation and association with LAI.

21-22 Mar 05: Executive Board Meeting, Dana Point, CA

The LAI Executive Board met in Dana Point, California on March 21-22. Prof. Sheila Widnall, Blaise Durante, and Chris Cool chaired the meeting, along with Bob Conner substituting for General Martin. The first portion of the meeting was devoted to a presentation by George Roth on the research activities in enterprise change. The guest speaker at dinner, Ms. Rita Murray, extended this topic in her remarks on mastering generational diversity in the workplace. Ted Piepenbrock captured the strategic interest of the board in his presentation on understanding lean enterprises through an architectural approach.

The second half of the board meeting was focused on status reports on the business model, strategic imperatives for Phase V, strategic alliances to assist in resource allocations, and systems engineering revitalization. As planned, the Executive Board meeting preceded the opening session of the LAI annual Plenary Conference, at which Prof. Sheila Widnall introduced the keynote speaker, Bob Conner.

Executive Committee**Teleconferences**

13 May 03, 15 May 03, 27 Jun 03, 3 Jul 03, 21 Jul 03

Meetings**11 Feb 03: LAI Executive Committee Meeting, Washington, DC**

The EXCOM met in Washington DC on February 11, 2003. The agenda consisted of lessons learned from the Dec. Executive Board Meeting, LAI governance, Lean Now status/update, the next steps for self-assessment tool development, and the Plenary Conference planning progress. There were several outcomes of the meeting of interest to the general consortium membership. Future Executive Board meetings will likely follow this pattern: a social dinner the night before an all day meeting, and a meeting focused on 2 to 3 goal related issues with plenty of time for discussion and decisions. It was decided at this meeting to focus the self-

assessment tool development on creating a Government LESAT. Meanwhile, interface processes knowledge will be captured from Lean Now activities.

17 Apr 03: LAI Executive Committee Meeting, Arlington VA

The Executive Committee met in Arlington, VA on April 17, 2003 with twenty participants. The agenda consisted of items to prepare for the May 22, 2003 Executive Board meeting. Each of the 6 LAI goals were reviewed for progress, definition of measures, and identification of issues to be brought to the Executive Board. There were also some issues identified that are not specific to any one goal, but reflect collective consortium governance and strategy. The issues identified at this meeting will be developed for presentation at the May Executive Board Meeting.

19 Jun 03: LAI Executive Committee Meeting, Arlington VA

The Executive Committee met in Arlington, VA on June 19, 2003. Each goal team reviewed their goal areas with emphasis on actions from the Executive Board meeting in May. Goal team 1 (Lean Transformation of Industry) and 2 (Enable Lean, Value-Creating, Supplier Base) met the previous day to develop their plans. Specific plans or approaches for each goal were discussed during the meeting getting suggestions and help from the rest of the Executive Committee. A team was formed to help define the LAI metrics.

18 Sep 03: Executive Committee Meeting, Dayton, OH

The LAI Executive Committee met in Dayton, Ohio on September 18, 2003. On the agenda was a review of progress in each of the LAI goals with particular emphasis on goals 3 (helping government transformation) and 5 (employee and organizational transformation). The committee was also briefed about the MIT research strategy developing from initial work in this phase with insights into the future research direction for the rest of the phase. The committee also received a report from the metrics team and discussed status of other LAI strategic imperatives. The next scheduled EXCOM meeting is November 6, 2003

6 Nov 03: Executive Committee Meeting, Washington, DC

The Executive Committee met in Arlington, VA on November 6, 2003. The meeting was split into two segments: topics to prepare for the LAI Executive Board Meeting on December 11th and topics for presentation to the LAI Executive Committee. In the first category each of the goal teams addressed progress and possible issues for the LAI Executive Board to consider. Following this information a draft agenda was presented and discussed for the executive board meeting. Finally, the executive committee discussed ideas about the LAI business model and how LAI@MIT knowledge areas link with the LAI Enterprise Value Phase goals.

With the changes in co-chairs, it was critical that LAI maintain stability in its leadership. Dr. Sheila Widnall has reengaged with LAI in her role as co-chair after her intense assignment on the Shuttle Review Board. Dr. Bill Kessler, at the request of the Air Force, has agreed to continue as industry co-chair. The LAI Co-Chairs, Dr. Bill Kessler and Institute Professor Sheila Widnall are seeking to meet with new LAI Co-Chairs, Mr. Blaise Durante and Gen. Martin in early December before the Executive Board meeting.

10-11 Dec 03, Executive Committee Meeting, Arlington, VA

The LAI Executive Committee met in the afternoon of December 10, 2003 in Arlington, VA. This meeting followed the LAI Co-Chair meeting (at Hanscom, AFB MA on December 8, 2003). At the Co-Chair meeting, which was also attended by Dr. Marv Sambur (SAF/AQ), there was a discussion about systems engineering. This discussion elevated the need to address systems engineering as a challenge to the LAI consortium. Therefore, at the Executive Committee meeting, much of the discussion was focused on thinking about how to address the systems engineering challenge posed by the LAI Co-Chairs plus Dr. Sambur. The output from this discussion was used to help shape the discussions the next day at the Executive Board Meeting.

5 Feb 04: Executive Committee Meeting, Washington, DC**22 Apr 04: Executive Committee Meeting, Washington, DC****23 Jun 04: LAI ExCom Strategic Imperative Team Meeting**

Held in St. Augustine, FL, this subgroup of the EXCOM met with Industry Co-Chair, Chris Cool, to articulate the strategic issues facing LAI. The meeting was a session to develop LAI's approach in a growth environment. The team will meet again on July 29, 2004 to prepare for the EXCOM meeting in September. Noel Nightingale will provide additional notes for the team members.

16 Sep 04: Executive Committee Meeting, Arlington, VA**4 Nov 04: Executive Committee Meeting, Cambridge, MA****30 Nov 04: Executive Briefing, A/F Space Missile Command, CA****Steering Council****27 Jan 05: Steering Council Meeting, Rosslyn, VA**

After the approval of the LAI Business Model Report by the Executive Board in December, the Executive Steering Council (the old Executive Committee with revised membership and charter) met for the first time. The agenda included a review and status of the action items from the Business Model Report. Of particular importance was the status on filling the Industry Co- Director, Government Co-Director, and LAI Transformation Director positions. Status also was given on program management, and other resource action items. The council formed two small teams to develop the Concept of Operations (ConOps) for the next phase of LAI and knowledge management methods for LAI. Reports were heard about the Plenary Conference planning and the Communications Working Group progress. New business addressed tentative approval of a new LAI transformation project: COMPASS CALL EC-130.

24 Feb 05: Steering Council Meeting, Cambridge, MA

14 Mar 05: Steering Council Teleconference

28 Apr 05: Steering Council Meeting: Dayton, OH

26 May 05: Steering Council Meeting: Washington, DC

23 Jun 05: Steering Council Meeting: Boston, MA

The LAI Steering Council met to review the LAI Concept of Operations (ConOps), progress on the LAI stakeholder value mapping process, prepare for the October 2006 Executive Board meeting and review the USAF Product Support Campaign project. The LAI ConOps will undergo some final modifications before the Steering Council co-chairs take it to the LAI Executive Board co-chairs for signature. The ConOps will be included in the consortium agreement amendment packages to be sent out in late July or early August. The stakeholder value stream mapping process is progressing, with plans for interviews to be completed by July 15 if possible. The interview findings and analysis will be addressed at the July 21 Strategic Business Model Team meeting. The Steering Council is reviewing the best method to convey to the Executive Board the LAI plan and use of resources, and showing how that relates to accomplishment of LAI imperatives. Finally, the Steering Council approved LAI engagement with the USAF on the Product Support Campaign, a transformation using enterprise-level methodologies of the Air Force Acquisition Process.

Strategic Business Model Team

28 Sep 04: Strategic Business Model Team Meeting, Rosslyn VA

1 Nov 04: Strategic Business Model Team Teleconference

10 Feb 05: LAI New Phase ConOps Team Meeting, Dallas, TX

29 Apr 05: Strategic Business Model Team Meeting, Dayton OH

25 May 05: Strategic Business Model Team Meeting, Washington, DC

22 Jun 05: Wed, Strategic Business Model Team Meeting, Boston MA

21 Jul 05: Strategic Business Model Team Meeting: Cambridge, MA

Network of Champions

Teleconferences

5 Feb 03; 5 Mar 03; 7 May 03; 6 Jun 03; 2 Jul 03; 6 Aug 03; 3 Sep 03; 9 Oct 03; 5 Nov 03; 3 Dec 2003; 8 Jan 04; 4 Feb 04; 3 Mar 04; 7 Apr 04; 5 May 04; 2 Jun 04; 7 Jul 04; 1 Sep 04; 6

Oct 04; 3 Nov 04; 1 Dec 04; 5 Jan 05; 2 Feb 05; 2 Mar 05; 6 Apr 05; 6 May 05; 1 June 05; 6 July 05

Meetings

8-9 Oct 03: Network of Champions Meeting, Cambridge, MA

On October 8th and 9th, 2003, the Champions met in Cambridge, MA. Those that could joined the Product Development Meeting for the demo of the PD training simulation (a part of the Enterprise Simulation Game) on October 8th. The Champions later convened for a social dinner before starting a full day meeting on October 9th. The meeting consisted of a strategic overview of LAI direction from Noel Nightingale followed by a series of presentations of current LAI products and research. These presentations updated the champions on the direction of the research and the status of the developing products such as the Enterprise Value Stream Mapping and Analysis (EVSMA) product, the Government LESAT, the Supplier Management Toolset and the Enterprise Simulation Game. The efforts of the LAI consortium on Lean Now were briefed and Ida Gall gave a presentation on one of the second round Lean Now projects, the AEDC Project which is a large scale enterprise engagement of multiple services and multiple engine manufacturers. Alexis Stanke also talked about the training that has been developed for Lean Now. After an update on the LAI Educational Network, the champions engaged in a discussion of several topics of interest to the group including a discussion of their role as champions for enterprise transformation in their organizations. Minutes of the meeting will be provided to the Champions via separate email.

2. Product Teams

Enterprise Value Stream Mapping and Analysis (EVSMA)

28 Apr - 2 May 03: EVSMA Alpha Test at Lockheed Martin, Stennis

Recently, a high-level Enterprise Value Stream Mapping and Analysis (EVSMA) event was held at the Lockheed Martin Mississippi Space & Technology Center (MS&TC) at NASA Stennis Space Center, MS. This event was a first of its kind, part of an Alpha testing program with the Lean Aerospace Initiative (LAI). The event involved senior leadership from the site in a week-long analysis of the MS&TC enterprise. The objective of the event was to help the group understand their current state through analysis of their stakeholders, strategic objectives, and enterprise processes and to define a future vision for their enterprise. By the end of the week, over forty improvement opportunities were identified and a plan was put in place to implement them over the next couple of years.

EVSMA is a methodology that extends the popular and effective Value Stream Mapping tool to an enterprise level. It provides a systematic way to explore the interactions between enterprise processes, the interrelationships between stakeholders, and the alignment of strategic objectives. Once a current state is depicted, a future lean enterprise vision is

constructed and opportunities to move the enterprise closer to the vision are identified. A working team under the auspices of the Lean Aerospace Initiative created the EVSMA methodology and guide. Alpha testing will lead to a Beta version, and then after additional testing a final version will be available to the entire LAI consortium.

According to Steve Hudson, MS&TC Director, "EVSMA provided our management team with several insights about how our enterprise actually functions. It also provided a way to identify improvement activities that support our total enterprise strategic objectives and optimize functional integration in the value stream."

15 Dec 03: Lean Enterprise Team Launched By MG Sullivan At Ogden ALC

On Dec 15th MG Sullivan, Commander of the Ogden ALC at Hill AFB, kicked off an executive leadership team for enterprise transformation. This team is chartered with performing an enterprise-level analysis of their current state, defining a future vision, and prioritizing a set of key projects to help achieve that vision. This project is an outgrowth of a successful Lean Now project on purchase requisitions as well as other shop floor maintenance repair projects that demonstrated the benefits of lean. Ogden ALC has now committed to applying the lean approach at the total enterprise level and is a strategic enterprise partner with LAI.

At this initial session the executive team developed their transformation charter and reviewed the EVSMA process as well as an approach to strategic visioning. The next steps will be training sessions on lean enterprise thinking followed by the launch of the EVSMA process. The transformation process will be facilitated by SMEs from Boeing and Raytheon, along with support from the MIT team.

6-7 Jan 04: Ogden ALC Enterprise Transformation Planning Meeting

An initial Enterprise Transformation Planning meeting was conducted 6-7 January 2004, to develop the preliminary engagement flow for the Ogden Air Logistics Center. LAI Team members from Boeing, MIT, and Raytheon were represented. The plan defined the inputs, the process, and the outputs for the LAI facilitated strategic planning events which will take place over the next six months at the Center. This engagement is the result of the 30 OCT 2003, Ogden Air Logistics Center off-site in which the center's senior leaders identified the need to look at transformation from an enterprise level to optimize their efforts.

2-6 Feb 04: C-17 EVSMA SME Event Kick-Off

During the week of 2 February, MIT and Boeing SMEs conducted a kickoff of the C-17 EVSMA which included core-team members from The Boeing Company, the C-17 SPO, and DCMA.

After core team introductions, an EVSMA Plan Review was presented by Boeing facilitators, followed by kickoff messages from Col. Jane Wofenbarger, (C-17 SPO Director), and from Steve Jungan and Greg Heesacker of Boeing.

Lean training and EVSMA training were then conducted by Boeing and MIT facilitators. Next, the core team began to complete the C-17 EVSMA Charter by brainstorming the Case For Action and Mission blocks.

The core team then discussed enterprise boundaries and two upcoming workshops in late Feb. and early March for progressing with the EVSMA process.

The core team will be joined by the C-17 management team for a third workshop in mid-March to continue the EVSMA process steps.

15-17 Mar 04: Enterprise Value Steam Mapping And Analysis with the C-17

Enterprise, Mesa, AZ

The LAI team facilitated the exercise of the Enterprise Value Stream Mapping and Analysis (EVSMA) tool with the C-17 enterprise on March 15-17, 2004. After preliminary data gathering including the administration of the Government Lean Enterprise Self Assessment Tool with the SPO and DCMA's Contract Management Office, LAI staff member Alexis Stanke assisted the C-17 leadership team complete the EVSMA process. This effort was captured by the "Boeing News Now" article dated March 29, 2004: C-17 Joint Leadership Team develops Lean Vision People working together as a global enterprise for aerospace leadership, was clearly demonstrated during a recent Lean Enterprise Executive Workshop that included top leadership from the C-17 SPO, DCMA, and The Boeing Company. Col. Janet Wolfenbarger, C-17 System Program Office director, Col. John Daniels, commander, DCMA-Long Beach, and David Bowman, Boeing vice president and C-17 program manager led selected members from their organizations through the Lean workshop held in Mesa, Arizona, March 15-17.

The workshop is part of an enterprise value stream mapping approach developed by the Lean Aerospace Initiative.

Col. Daniels noted, "This is a real breakthrough for the program. Leadership is defining the C-17 enterprise in a new way -- beyond just partnerships between SPO, DCMA, and Boeing."

Dave Bowman emphasized that "...the last three days have involved advanced leadership principles where there is no template." He added that the leadership team needs to focus on the execution of ideas that have surfaced during the workshop, "Six thousand people will watch us when we get back to work and see if we are serious about this effort, or if we just talk it-that's our challenge," Bowman said.

"The benefit of a joint enterprise approach is that the workforce will see the C-17 program having one voice with one purpose, that is to produce the finest quality product and the lowest possible cost for our war fighter customer," stated Al Parker, director of Quality, IDS-Long Beach.

Col. Wolfenbarger closed the workshop emphasizing, "...this process (enterprise value stream mapping) exemplifies the never ending commitment to improvement by C-17 enterprise leadership."

25 Mar 04: Ogden ALC ELT Meeting

A special Ogden Air Logistics Center Executive Leadership Team meeting was held on 25 March in conjunction with the LAI Plenary. Along with the Ogden team, attendees included representatives from Arnold Engineering Development Center, and Tinker Air Logistics Center. The intent of the meeting was to allow for dialogue between LAI executive members and the Ogden ELT on all aspects of developing plans for transforming their enterprise to lean. The focus of this dialogue was the shared experiences of LAI executive members who have been involved in their own company's transformation. The discussion topics selected for the dialogue were chosen from the sequence of steps depicted in LAI's Transition to Lean Roadmap (TTL). The format allowed one LAI member to present, their particular experience in executing that particular step of the TTL in their company and to describe how they were successful in accomplishing it. The intent of the discussions which followed, allowed the ELT to fully understand the nuances of the particular step in the TTL. The goal of the meeting was to provide the Ogden ELT with enough information, background and confidence to enable them to begin to outline and develop their strategic lean transformation plans. Discussion Topics included,

1. Linking Lean with Enterprise Strategic Planning Presenter: John-Paul Besong from Rockwell Collins - A discussion on how to effectively link any and all lean activities to the strategic direction of the enterprise.

Sub-topic: Outcome on enterprise

Presenter: Noel Nightingale from LAI - A discussion on how to monitor the progress of the transformation; that is both the progress of improving the capability of the people and the bottom line operational improvement of the enterprise.

2. Focusing on the Value Stream

Presenter: Chris Cool from Northrop Grumman - A discussion on how the value stream of the whole enterprise is evaluated to insure that the most crucial process steps and those that are negatively affecting its performance can be identified and given focus from the very beginning of the transformation.

3. Developing Lean Structure and Behavior

Presenter: Jim Davis from Boeing - A discussion on how structural changes to the organization of the enterprise, resources allocations and the assignment of change agents are most effectively executed.

4. Transformation Planning

Presenter: Lisa Kohl from Northrop Grumman - A discussion on how to plan the activities for the transformation and how to develop the capabilities of the people to achieve the transformation.

Sub-topic: Developing Detail Plans

Presenter: Noel Nightingale from LAI - A discussion on what constitutes an effective plan, what it must contain, its duration and format.

The meeting was an informative and detailed filled day that provided the information needed to begin the process of establishing a strategic lean deployment plan.

12-13 Apr 04: Ogden ALC ELT Meeting

An ELT meeting was conducted 12-13 April at Ogden as part of the continuing Strategic Enterprise partnership with LAI. On the 12th the team discussed the Black Belt candidates selection process and began the initial steps to develop the Strategic Lean Deployment Plan for the Center and to define the lean communication plan for the center. On the second day the team reviewed the product value stream data collected to date, reviewed outstanding action items and finalized the data collection prior to the selection of a focus area. Significant discussions were held concerning the roles and responsibilities of all the individuals responsible for effective lean deployment, Black Belts, team leads, sponsors, lean champion, etc. At the next ELT meeting the focus area(s) will be selected and business diagnostics begun for those areas selected using the candidate black belts and industry mentors.

29 Apr 04: EVSMA Briefing, Oklahoma City ALC

On 29 April, LAI Co-Directors, Terry Bryan and Debbie Nightingale presented LAI and the Enterprise Value Stream Mapping and Analysis methodology to the Oklahoma City Air Logistics Center (OC-ALC) leadership team. Oklahoma City will be the next Air Force Material Command logistics center to conduct an enterprise analysis of their center, following in the footsteps of the Ogden Air Logistics Center and the C-17 program which used the alpha version of the EVSMA. The EVSMA will mature to a beta version before engagement at OC-ALC. EVSMA expands the successful technique of value stream mapping and analysis to enterprise application and provides a coherent method for analyzing and improving enterprise performance, integrating, strategic objectives, stakeholder interests and process performance, all with an enterprise viewpoint. EVSMA provides supporting tools for the LAI Enterprise Transition-to-Lean (TTL) Roadmap. Engagement with the Oklahoma City Enterprise Leadership Team is planned to occur within the month. Through the use of the EVSMA methodology, an enterprise view of lean deployment will be established to aid in the deployment of lean methodologies within the logistics center.

8-10 Jun 04: LAI - Oklahoma City Enterprise Leadership Team EVSMA

Workshop a Success -- June 8 - 10 -- Oklahoma City, OK. A team consisting of LAI members, representing MIT, Boeing, and Raytheon, engaged the Oklahoma City Enterprise Leadership Team (ELT) to begin their journey through the LAI-developed Enterprise Value Stream Mapping and Analysis methodology. The first day was a facilitator-only meeting to review past EVSMA events, input lessons learned into the current process, and develop the next two-day facilitator plan for the engagement. The second day's morning was dedicated to team briefings for the facilitator team and a tour of the Oklahoma ALC facilities to familiarize the team with the center operations.

7-8 Jul 04: Oklahoma City ALC EVSMA Take-Aways

This session developed stakeholder values analysis, process data, goals metrics alignment and process interactions. A review of the center's communications plan also was conducted.

The two-day event was an in-depth look at the total, center-wide enterprise. Final data collection is proceeding and analyses have begun to finalize the portrayal and analysis of the center's "as-is" condition. Final data analysis is scheduled for July 20-21 in preparation for the next phase of the analysis, strategic visioning, where the "to-be" state will be defined. This is slated for the week of August 9.

13-14 Jul 04: Ogden Air Logistics Center Take-Aways

Members of the Enterprise Leadership Team (ELT) began the process of establishing a balanced scorecard, leveraged off of the EVSMA conducted recently, and establishing the planning necessary to accelerate the deployment of lean methodologies throughout the center. Basic steps were identified as strategic visioning (completed as part of the EVSMA); identifying high-level center metrics; identifying sub-metrics that drive high-level metrics; and identifying initiatives that will improve sub-metrics. The ELT began the process of establishing the planning necessary to continue the lean transformation of the center. Deployment included plans for communication; project management; success measurement and reinvestment; concept of operations; baseline information gathering and education; benchmarking; balanced score card initiation and development of a center-wide master transformation plan. A mid-course review of the planning will be held in late July with an ELT review in early August. LAI members MIT and Raytheon supported the effort.

26 Aug 04: Major EVSMA for Oklahoma City, OK ALC Completed

26 August marked the completion of an intensive, three-month effort to complete an EVSMA at the enterprise level for the entire ALC. The ALC Enterprise Leadership Team (ELT) comprised of senior leaders within the center was led by Mr. Robert Conner, the Center's executive director (recently promoted to executive director for Air Force Material Command). The objective of applying the EVSMA methodology was to optimize the enterprise value stream as a critical element in formulating a strategic business plan to aid in the transformation of the center as a lean enterprise.

The EVSMA methodology provided a methodology to:

- 1) identify barriers to the creation/delivery of value to each stakeholder
- 2) specify a vision of the future lean enterprise
- 3) determine significant gaps between current and future states, and
- 4) prioritize opportunities for eliminating waste and increasing value creation/delivery for the maximum benefit of the total enterprise

The ALC team developed a concise definition of the enterprise, identified and evaluated stakeholders, processes and metrics, developed a current state perspective and enterprise opportunities, developed a future state vision and created a suite of enterprise projects to close the gap between the current state to the 2-3 year strategic outcome. A set of 7 projects were identified as key projects to begin immediately. As an adjunct to the EVSMA process, 10 black belt candidates have been selected from the Center, representing all aspects of the enterprise, who are undergoing black belt training and will be mentored by LAI Subject Matter Experts during the initial stages of their lean journeys. The EVSMA process and mentoring is supported by LAI members representing Boeing, MIT, Pratt and Whitney, and Raytheon. Congratulations and smooth sailing for the Oklahoma City Air Logistics Team!

1-2 Sep 04: Enterprise Leadership Team meeting at Ogden Air Logistics Center

An Enterprise Leadership Team meeting was conducted on these dates as part of the ongoing enterprise transformation efforts at the Ogden Air Logistics Center. The major subject of the meeting was to begin the development of the Balanced Score Card (BSC), a follow-on to the EVSMA process conducted at the center. BSC training was conducted and teams were assigned to begin the process of establishing the center- wide BSC as a precursor to flowing the BSC to the entire center. Additionally, three projects were identified in which to deploy the 11 black belt candidates at the center. Plans also were developed to complete the EVSMA process to develop a set of enterprise projects.

19-20 Oct 04: Ogden ALC ELT, Ogden, UT**3-4 Nov 04: Ogden ALC ELT, Ogden, UT****17-18 Nov 04: Ogden ALC ELT, Ogden, UT****1-2 Dec 04: Ogden ALC ELT, Ogden, UT****15-16 Dec 04: Ogden ALC ELT, Ogden, UT****16 Feb 05: LAI-AF Meeting, Cambridge, MA****29 Apr 05: LAI's Event Value Stream Mapping Analysis Event at Robins ALC Makes Front-page Headlines**

In the center's weekly newspaper, *Robins Rev Up*, In an article entitled "Center sets course to dominate sustainment", the joint effort by LAI and Simpler Consulting (which originated in 1999 as a much smaller project) to map the center's current and desired future states received glowing reviews from participants in the complex transformation.

A key milestone was the definition of this future state. As LAI's co-director, Professor Debbie Nightingale of the Massachusetts Institute of Technology noted: "This is a statement of where you want to be 10 years from now that is realistic enough that people understand it, yet bold enough so that people gasp when they see it." The center's goal in simple terms? "Be America's dominant air and space power sustainer by 2015."

Lean Enterprise Value Simulation Game**24 Aug - 10 Sep 04: Enterprise VSM Event at Textron Systems: Wilmington, MA**

Textron Systems mapping the enterprise value stream of its Sensor Fused Weapon (SFW) program with the help of LAI consortium members and the Massachusetts Manufacturing Extension Program (Mass MEP). The events included participants from Textron Systems, the USAF customer, several suppliers, and Cessna Aircraft. Supporting the effort were LAI/MIT, Rockwell Collins, Mass MEP, and Metis Design (who helped deliver the LEV simulation.)

The overall objectives of the event were to identify opportunities to accelerate implementation of lean principles and practices at the SFW program enterprise level, to elevate enterprise value stream thinking among participants, and ultimately deliver more SFW systems to the user for a given program budget level.

The event kick-off took place August 24, with a tutorial on lean principles and a short simulation of lean manufacturing lead by Mass MEP. Participants were given an overview of the overall objectives of the effort. A week later, participants reconvened to begin developing the enterprise value stream maps (EVSMs). Participants went through the LAI Lean Enterprise Value (LEV) Simulation to develop enterprise thinking and value stream mapping skills, and then created preliminary value stream maps for the SFW program. The LEV Simulation and EVSM activities were supported by facilitators from Rockwell Collins, MIT/LAI, and Metis Design. The LEV Simulation provided the mechanism for all the program stakeholders to understand the enterprise interactions that enable a robust way to develop a program's value stream quickly and efficiently. Students from LAI/MIT also participated and gained further perspective and skill development on enterprise transformation activities underway in the consortium.

Areas in the EVSMs for additional focus were identified by the participants, and the group concluded with assignments to collect more detailed information to refine the EVSMs. The group met again later to complete the EVSMs and identify lean improvement actions and next steps. The event was considered a success and demonstrated again the ability of the LAI community and others to come together in support of enterprise-level improvement efforts.

Supplier Transformation Toolset

24 Mar 03: Supplier Networks Working Group Meeting

The Supplier Networks Working Group held a meeting prior to the LAI Plenary Conference to review some of the early feedback on the beta-testing of the Supplier Management Assessment Tool. Initial feedback is quite favorable. Extensive additional feedback is expected to be received shortly. The group also discussed the status of the two other complementary tools (ROADMAP; REFERENCE GUIDE) and how best to integrate the entire toolset. The group decided to develop and disseminate a web-based toolset allowing users easy access to the various components, as needed, rather than to issue a hard-copy report. It was agreed that a web-based product would make it easier in the future to introduce on-going improvements and insertion of additional features.

In general, the initial feedback -- subject to a few further clarifications from the respondents -- indicates that the tool is perceived to be well organized, fairly clear, highly relevant, quite easy to use, contains the critical success factors, and has the right level of detail. The initial feedback also indicates that the usefulness of the tool can be enhanced by helping to define more clearly the path forward for making further process improvements. Consequently, the group formed a continuous improvement core team to enhance the tool's usefulness based on the beta-test results. In particular, the team will concentrate on the "how-to" transitioning

tasks to move from the "current state" to "desired future state", which will entail a closer integration of the ASSESSMENT and ROADMAP tools.

The group's next working meeting will take place on April 29-May 1 in Seattle, to be hosted by The Boeing Company. At this meeting, the group will review progress on all three components of the toolset, including further beta-test results, and work towards the completion of Version 1.0 of the toolset.

3-5 Jun 03: Supplier Networks Working Group Meeting

Hosted by the Boeing Company in Renton WA, the meeting focused on a review of the beta-test results on the Supplier Management Assessment Tool and improvement of the tool based on the feedback. The beta-test covered 14 companies (3 primes [one of which provided feedback from 4 separate sites/functional areas], 3 major suppliers and 8 smaller suppliers). The feedback from the primes and first-tier suppliers was generally very positive. Smaller suppliers (not all, but some) seemed overwhelmed by it and provided helpful feedback for simplifying the tool. The team reviewed the beta-test feedback and put priority emphasis on improving the tool's usefulness for primes and major suppliers, as well as on making it accessible and useful for smaller suppliers.

The group created a number of subteams to continue making improvements. Meanwhile, the ROADMAP tool is about to be issued for beta-testing. The Reference Guide, the third major component of the toolset, is still under development. The group expects to complete TOOLSET Version 1.0 by early September, 03. The next meeting is scheduled for the week of August 25-29 (most likely Aug 25-27), to be held either in Cincinnati or Boston.

26-28 Aug 03: Supplier Network Working Group Meeting

This meeting of the team, held at MIT, concentrated on the further development of the Supplier Transformation Toolset. The team worked on the Assessment Tool to simplify it further and make it more user-friendly, based on the earlier beta-test feedback results. The team also reviewed, critiqued and improved an updated and more complete version of the Roadmap Tool, which is now more tightly integrated with the Assessment Tool. In addition, the team designed a front-end questionnaire screening module to gauge the degree of lean preparedness of potential user companies, in order to guide them appropriately towards the utilization of the Toolset as well as other enterprise-level LAI products and tools. Then, the team designed a Resource Guide to assist mostly smaller suppliers that may not yet be ready to derive the full benefits of using the Toolset -- based on the results of the initial screening module -- to help them identify sources for learning more about basic lean manufacturing concepts. Finally, the team decided to continue work on developing a Desk Reference containing a description of key lean supply chain design and management concepts and principles.

In light of the team's planned future activities to flow lean principles to lower-tier aerospace suppliers, the team had two invited presentations. The first, by Susan Moehring (TechSolve) and Jim Gilbert, focused on lean delivery to lower-tier suppliers (methods, tools, organizations, terms of engagement, funding sources). The second, by Julie Gissel (Boeing Long Beach C-17) and Mickey Wiebe (Executive Director, Supplier Excellence Alliance --

SEA), focused on the new SEA initiative (goals, objectives, organization, service delivery approaches). SEA is an association of leading aerospace, defense and space prime contractors whose purpose is to develop the capabilities of their common suppliers.

The team is planning to issue Version 1.0 of the Toolset by December 03. The next meeting of the team is scheduled for November 24-25 in Indianapolis, to be hosted by Rolls-Royce.

24-25 Nov 03: Supplier Networks Working Group Meeting, Indianapolis, IN

This working group meeting was hosted by Rolls-Royce in Indianapolis November 24th and 25th. The group concentrated on reviewing and further improving the ROADMAP Tool designed to provide primes and first-tier suppliers with a structured process for evolving lean, value-creating, supplier networks. The team also considered a number of agenda items to help define LAI's value-added role in enabling lean, value-creating, supplier base (LAI Goal 2) and to plan the group's activities into 2004: (1) supporting "common core assessment capability" for primes and first-tier suppliers; (2) supporting NIST-MEP and other organizations on consistent and high quality lean methodology and deployment at subtier level; (3) supporting more effective linkage of first-tier suppliers to lower-tiers; (4) defining value proposition for all stakeholder categories in the supplier value stream that supports "speed of capability to the warfighter"; (5) conducting a comparative examination of supplier lean assessment tools (their similarities and differences); and (6) refining metrics and defining a process for survey data collection to assess how deeply and broadly lean practices are being deployed. The group will continue addressing these topics to accelerate "traction" on them in the months ahead.

The group's next meeting is scheduled for Feb 17-18 in the Los Angeles area (to be hosted by CMTC -- to be confirmed). At this meeting, the first day will be devoted to a series of presentations by representatives of LAI stakeholder member organizations on supplier lean assessment tools they are currently using. A separate announcement on this is forthcoming. All are cordially invited to participate at this unique event that should provide valuable cross-learning opportunities for all of the participants. The second day of the meeting will be devoted to a comparative review by the team of the various tools being deployed for supplier lean assessment. Also, a hyperlinked version of the SUPPLIER TOOLSET will be reviewed.

Here is the schedule for the team's activities related to the SUPPLIER TOOLSET: (a) Version 1.0 (Roadmap & Self-Assessment tools as an integrated document) is to be made available on the LAI website by end-December, 03; (b) Version 1.1 (hyperlinked version of the document) to be made available on the LAI website by end-February 04; (c) Version 1.2 (addition of the DESK REFERENCE module -- concise compilation of core lean concepts and principles governing lean supply chain management) is scheduled to be available on the LAI website by end-March 04 (or immediately following the LAI Plenary Conference, whichever comes later); (d) Version 1.3 (addition of the RESOURCE GUIDE (basic lean resources guide -- "yellow pages plus" designed primarily for smaller suppliers), currently in the planning stage, will be developed in partnership with selected lean delivery organizations focusing on subtiers (timeline to be determined).

18-19 Feb 04: Supplier Networks Working Group Meeting, Ft. Worth, TX

This meeting, conducted February 18-19, was hosted by Lockheed Martin Aeronautics in Fort Worth, TX. The group addressed two major agenda items: (a) exploring the idea of developing a common set of tools that all LAI stakeholder organizations can use for supplier lean assessment; and (b) defining a collaborative framework for "enabling a lean, value-creating, supplier base" (LAI Goal 2). These two items were in direct response to a request by the LAI Executive Committee. Also, as a side item, the group briefly reviewed status on Version 1.0 of the Supplier Networks Transformation Toolset. This is an integrated toolset for building lean supplier networks (an implementation ROADMAP Tool and a SELF-ASSESSMENT Tool are linked together).

The team considered the first item by reviewing a number of supplier lean assessment tools currently being used by LAI member companies (e.g., Lockheed Martin Aeronautics, Boeing Commercial Airplanes & Boeing Integrated Defense Systems, Textron Systems, Rockwell Collins), as well as those used by organizations delivering lean services to lower-tier suppliers (e.g., California Manufacturing Technology Center -- CMTC, Garden City, CA; TechSolve, Inc., Cincinnati, OH). The group's overall sense was that developing a common toolset for supplier lean assessment for the purpose of gauging the lean/six sigma capability levels of lower-tier suppliers would probably not represent a value-added service by LAI at this time, since companies typically use not a single tool but an array of tools serving their individual diagnostic, performance evaluation and supplier certification needs, which are all tied to their respective supplier improvement processes and programs. The group felt that before addressing this topic any further the challenge of evolving a collaborative framework for helping to improve the capabilities of a common supplier base should be tackled first.

The group then discussed the idea of evolving a collaborative framework with other organizations to help improve the capabilities of the supplier base. One major conclusion was that it would be necessary to take an "end-to-end, integrated, view of the larger acquisition value stream from the customer to prime (system integrator) to first-tier suppliers to lower-tier suppliers." This led to the next conclusion that, to be effective, the collaborative framework must take a systems view of the US aerospace enterprise. This, in turn, meant two basic challenges: (a) "leaning-out" the interfaces up-and-down the (acquisition) value stream, and (b) accelerating the flow of lean thinking to the common lower-tier supplier base. It was felt that, within a collaborative framework (to be defined), LAI could best help tackle the interfaces challenge, while the challenge of flowing lean to lower-tiers could arguably be best handled by NIST-MEP (and perhaps other, affiliated, organizations), deploying a nationwide network of centers and providing a consistent, high-quality, set of implementation tools and practices. Next steps would include fleshing out these ideas more fully for discussion and feedback at the next team meeting (March 22, 04), just prior to the LAI Plenary Conference (March 23-24, 04).

Finally, the group gave the "go-ahead" for making the Supplier Toolset available on the LAI website. Pending a few minor revisions, this task will be accomplished shortly. The Supplier Toolset will be introduced publicly at the team's March 22, 04 meeting.

22 Mar 04: Supplier Networks Working Group Meeting, Dana Point, CA

The meeting, held March 22nd at Dana Point CA, addressed two important agenda items: (1) public introduction of Version 1.0 of the Supplier Networks Transformation Toolset (which has been posted on the LAI website) and (2) development of a collaborative framework for "enabling a lean, value-creating, supplier base" (LAI Goal #2). In view of the large number of "first-time" participants at the meeting, the session was kicked off by an overview by Kirk Bozdogan (MIT Co-Lead) summarizing the team's charter, membership, activities and progress. Next, a general description of the toolset was given by Kirk Bozdogan and Kerry Frey (Industry Co-Lead; Lockheed Martin Aeronautics). Following this, Kirk Bozdogan and Chris Darden (Northrop Grumman Integrated Systems) presented, for discussion, a summary of the team's early thoughts on the development of a collaborative framework bringing together LAI and other organizations with complementary interests in helping to evolve a robust and lean domestic supplier base. The ensuing group discussion highlighted several points: (1) it is important to define the "pull" from the customer to drive such a collaborative initiative; (2) it would be desirable to define the common expectations of both primes and their major suppliers from the lower-tier supplier base; (3) it would be helpful to sharpen the distinction between those activities serving the particular needs of individual first-tier companies and those activities that could be jointly undertaken -- in partnership with other organizations -- that would enhance the common interest.

The team plans to continue pursuing the development of a collaborative framework and the associated business model for consideration by LAI's Executive Committee. The group's next meeting is tentatively scheduled for the first week in June (May 31-June 4) -- with exact dates to be determined -- to be hosted by TechSolve, Inc. in Cincinnati, OH.

25-26 Aug 04: Supplier Networks Working Group Meeting, Cambridge, MA

Held on August 25-26, the meeting, convened at MIT, addressed two major agenda items: (a) expediting completion of the Supplier Networks Transformation Toolset, and (b) action-oriented activities aimed at enabling the development of a lean, value-creating, aerospace supplier base. On the first, the group made progress toward designing the content of the Desk Reference and the Resource Guide -- the two remaining components of the Toolset - and developing an implementation plan for their completion. An alpha version of both modules is expected to be ready for review by the team in mid-November. On the second, the team identified a number of high-leverage areas where LAI can provide value-added enabling assistance and selected one of them for immediate attention.

The selected area concerns accelerating the flow of lean principles to lower-tier suppliers through collaborative arrangements with other stakeholder organizations. A sub-group working on this specific area developed a concept plan that will be evolved into a white paper by September 30. Following its review by the group, the white paper will be submitted to the LAI leadership for further action.

The emphasis on accelerating the flow of lean thinking to lower-tier suppliers is a major element of the group's larger vision (articulated at its February 18-19, 2004 meeting in Indianapolis hosted by Rolls-Royce), namely, that it is necessary to take an "end-to-end, integrated, view of the larger aerospace acquisition value stream from the customer to prime

(system integrator) to first-tier suppliers to lower-tier suppliers" in order to help evolve a lean, value-creating, aerospace supplier base.

In addition to its regular core membership representing many LAI stakeholder organizations (in both industry and government), the group included new invited participants from the Defense Contract Management Agency (DCMA), the Doyle Center for Manufacturing Technology, and the MEP Management Services, Inc., as well as continuing participation by representatives of key supplier-oriented lean service delivery organizations, such as the California Manufacturing Technology Center (CMTC).

Briefings to the group included a presentation on DCMA's management councils (Don Reiter), a description of the activities of the Doyle Center for Manufacturing Technology (Dennis Thompson), and an overview of the activities of MEP Management Services, Inc. (Don Chappell). These briefings were preceded by an opening overview presentation (Kirk Bozdogan) on the mission and major thrust of the group, a status report on the toolset development effort (Kirk Bozdogan; Kerry Frey; Hamid Akhbari), and a preliminary definition of the options framing LAI's going-forward role (Kirk Bozdogan; Hamid Akhbari; Kerry Frey; and Chris Darden). An agenda of the meeting and a complete set of the presentations will be posted on the LAI website (under "Supplier Networks Working Group").

The group's next meeting is scheduled for November 17-18. The location will be announced shortly. At this meeting, the group will review the alpha version of the Desk Reference and the Resource Guide modules, as well as the concept paper on accelerating the flow of lean principles to lower-tier suppliers.

17-18 Nov 04: Supplier Networks Working Group Meeting, El Segundo, CA

On November 17 and 18, and hosted by Northrop Grumman in El Segundo, CA, the LAI Supplier Networks Working Group met with key lean-enabling organizations (e.g., NIST MEP 360 vu; MEP Services, Inc.; Supplier Excellence Alliance -- SEA; California Manufacturing Technology Center -- CMTC; TechSolve, Inc.). After reviewing the team's progress in developing two additional modules of the supplier toolset (the Desk Reference & Resource Guide, respectively), the group recalibrated its strategic direction in light of two important recent developments: (1) a comprehensive reassessment of the LAI value proposition, indicating the need for addressing interface issues, and (2) a major initiative by the DCMA in the subcontracting management area, providing a synergistic opportunity for collaborative action.

22-24 Feb 05: Supplier Networks Working Group Meeting, Celebration, FL

Hosted by MEP Management Services, Inc. (MEP MSI) in Celebration, FL, the meeting concentrated on the further exploration and refinement of the *Lean Supply Chain Now* pilot demonstration project concept. Preceding activities included an overview of the team's overall thrust and activities, progress on the development of the *Desk Reference* and *Resource Guide* modules of the supplier toolset, and a summary of the *Lean Supply Chain Now* pilot concept based on the group's earlier meeting. Other briefings included the strategic

plan of the Supplier Excellence Alliance for 2005, and the portfolio of services and products offered by MEP MSI.

The objective of the *Lean Supply Chain Now* pilot project is to design, test and develop a validated, portable implementation model for streamlining vertical interfaces in the multi-level aerospace supply chain to improve supplier network performance that can be deployed widely in the US aerospace community. The team focused on exploring and defining the business model, pilot design, execution plan, and outreach plan for the pilot project. The group further defined the vertical interfaces characterizing the aerospace supply chain and prioritized them for consideration in the pilot project.

Two special learning sessions were organized by MEP MSI. These included a review of MEP MSI's Time Wise Solutions portfolio of training and implementation products and services, and a facilitated supply chain simulation event involving the group's participation.

10-11 May 05: Supplier Networks Working Group Meeting, Cincinnati OH

Hosted by TechSolve, Inc., in Cincinnati, OH, this meeting concentrated on further definition and planning of the Lean Supply Chain Now pilot demonstration project concept. A number of activities and presentations preceded the group discussion. These included: (a) an overview of the team's activities (offered by Kirk Bozdogan); (b) a progress report on the Desk Reference and Resource Guide -- the two remaining modules of the supplier toolset -- (made by Kirk Bozdogan and JK Srinivasan); (c) a synopsis of the Lean Enterprise Certification Program by the 360 vu Research and Education Foundation (by Brian Sweeney); (d) a presentation on the electronics industry-wide network for characteristics and renaissance services (presented by John Crabill of AFRL/MLMT and Bob Morris of Renaissance Services); and (e) a presentation entitled "Building the Lean Extended Enterprise through Adaptive Supply Chain Networks" (by Tom Shaw of the Government Electronics and Information Technology Association).

24-25 Aug 05: Supplier Networks Working Group Meeting: Cambridge, MA

Hosted by LAI at MIT, this meeting concentrated on designing the implementation methodology and process that will be followed in executing the Lean Supply Chain Now Concept Demonstration Initiative. The goal of this new initiative is to develop a validated best-practices implementation methodology package for streamlining vertical interfaces in the multi-tiered aerospace supply chain, through a number of pilot projects focusing on the technical data flowdown process, to eliminate waste, shorten cycle time and improve quality. (An early draft of a white paper on this initiative is provided on the LAI Web site, with an updated version forthcoming soon.)

The group defined a consensus implementation roadmap for the pilot projects at a generic level. The group further refined the generic roadmap for implementation in the more specific context of the initial test-bed (alpha) pilot project. The alpha project will focus on the C-17 Globemaster program enterprise, to be hosted by the Boeing C-17 supply chain management leadership at Long Beach, CA. The group also defined a number of areas for further exploration prior to the launching of the alpha pilot project, in such areas as benchmarking other supplier interface projects focusing on technical data flowdown, prime supplier portals

for managing interfaces with suppliers, training and educational materials, further refinement of the white paper, and potential external funding sources for executing the pilot projects.

Government Lean Enterprise Self Assessment Tool (Government LESAT)

15-16 Sep 03: Global Hawk Becomes First Government Organization To Test Government LESAT

On September 15-16, 2003, the Global Hawk System Program Office (SPO) assessed its organization with the Government Lean Enterprise Self Assessment Tool (Government LESAT) alpha version at its offices in Wright-Patterson AFB, Ohio. In three two-hour sessions facilitated by an MIT facilitator, the SPO leadership and IPT teams completed the Government LESAT. MIT will facilitate the self assessment analysis and assist the SPO in its upcoming feedback session on October 6, 2003. Valuable feedback about the tool itself will be captured from the SPO participants. This is the first test of the Government LESAT alpha version. Any other government organization wishing to administer this government lean enterprise self assessment tool should contact Tom Shields at 617-253-7333 or shields@mit.edu.

6 Oct 03: Government LESAT Alpha Test At Global Hawk SPO

On September 15-17, 2003 the Global Hawk SPO undertook a System Program Office (SPO) lean self-assessment using the alpha version Government Lean Enterprise Self-Assessment Tool (LESAT). The Global Hawk SPO was the first government organization to test this tool. On Oct 6, 2003 a facilitated debrief session was held with the SPO where the SPO leadership discussed the implications of the Government LESAT results and determined an action plan to go forward.

3. LAI Annual Plenary Conference

25-26 Mar 03: Dayton, Ohio

The annual Lean Aerospace Initiative Plenary Conference convened on March 25, 2003 in Dayton, Ohio with a theme of Transformation Across Enterprise Boundaries, "Pioneering the Future of Aerospace." The opening session was convened by LAI Co-Chair, Dr. Bill Kessler. LAI today, a presentation by LAI's Co-Director, Debbie Nightingale, explored LAI's past and future with its focus on the enterprise and the value proposition network. There is real work right now that supports the consortium goals and accelerates lean enterprise transformation - "Are you ready to flap your wings?"

General Lester Lyles, Commander, Air Force Materiel Command and Dan Burnham, Chairman and CEO, Raytheon Company were the Conference keynotes. They talked about enterprise transformation from the government and industry perspectives. Thoughts and discussions about enterprise transformation were explored with the attendees in a panel

session consisting of Dick Millman, Textron Systems Corp., Dick Lewis, Rolls Royce and S. K. Gupta, Lockheed Martin.

There were two breakout sessions on topic areas starting on the afternoon of the first day and concluding on the morning of the second day. Separate write-up for each session are included below.

The concluding plenary session was focused on "Accelerating Government Transformation." Hosted by LAI's Stakeholder Co-Director, Terry Bryan, presentations featuring the progress and scope of "Lean Now," lean depot repair and lean at Air Mobility Command were presented. Major General Mike Mushala opened and commented extensively on the "Lean Now" presentations from F/A-22, F-16 and Global Hawk. Major General Don Wetekam talked about Warner Robins Air Logistics Center Lean Depot Repair achievements. Finally concluding the session and rounding out acquisition, logistics and lastly operational USAF lean efforts, Major Steve Newlon described lean implementations at the Air Mobility Command.

BREAKOUT SESSIONS:

Experiencing Enterprise Transformation

This break-out featured three speakers who shared their experiences and insights to transforming enterprises. Paul Mullenhour from the Lean Learning Center emphasized lean as a fundamental way of thinking and the importance of identifying an organization's operating system as a framework for understanding how transformation will take place. George Koenigsaecker from Lean Investments LLC presented lessons learned from several successful transformations to lean. He talked about striving for goals and how high those goals should be in order to avoid underestimating the power of lean implementation. He also discussed focusing on productivity as a key metric for lean transformation as well as the importance of continually revisiting areas where lean has already been implemented as a way to increase returns on improvements. Cory Hallam from MIT presented insights from studying the LESAT data from several companies in the US and the UK. He identified correlations between leadership, enabling, and lifecycle processes, as well as a model for leveraging the LESAT results in strategic planning.

Transition To Production

The session featured five presentations on transition to production, often a challenging process for many enterprises. The first was a joint presentation by Ed Peterson (Aerojet Corp.) and Bob Morris (COHESIA Corp.). Ed Peterson's presentation, entitled "Lean Production Transition -- Value Stream Analysis at Aerojet," highlighted the importance of value stream mapping (VSM) in product development as a key enabler of successful transition to production through the implementation of systems engineering methods, standard work, improved processes, and training. The presentation by Bob Morris, entitled "Lean Production Transition -- Characteristic Lifecycle Management and Engineering Readiness Levels," introduced a systematic method, now available for implementation, for

capturing, organizing and moving knowledge during the product development and transition to production cycle, as well as for measuring the knowledge captured.

Next, the presentation by Benjamin DeLange (Raytheon Missile Systems), entitled "Tomahawk Depot Factory Flow," described how the Raytheon Six-Sigma approach has been deployed to accelerate the production and delivery of remanufactured Tomahawk missiles by increasing throughput, reducing cycle time, and improving quality.

Rhonda Smith and Brad Peters (The Boeing Company) addressed the topic "Production Preparedness Process (3P) and the F/A-22 Program." They gave an account of how the Production Preparedness Process (3P) has been used to "revolutionize" the assembly methods for the F/A-22 Aft Fuselage and Wings to cut assembly flow time, reduce costs and increase flexibility in order to "beat" the F/A-22 cost curves.

In a presentation entitled "Achieving On-Time Delivery (BAT -- Brilliant Anti-Tank -- Production), Kevin McDonald (Raytheon Missile Systems) detailed how the Raytheon Six-Sigma approach has been deployed in the BAT program to overcome "show stopper" technical problems and to accelerate the production level beyond the possible maximum capacity available, after the program had transitioned from EMD to LRIP 1 and LRIP 2, and had, further, physically moved from Andover, MA to Tucson, AZ.

Finally, Prof. Bo Oppenheim (Loyola Marymount Univ.), in his talk entitled "Quality Self-Assessment Perspective of Junior Engineers," summarized the results of an 85-question survey on quality that was designed and administered to a relatively small and nonrandom sample of graduate engineering students at Loyola Marymount University. A major conclusion is that total quality (TQ) is poorly practiced, as observed by the surveyed junior engineers, and that to ensure successful lean implementation a focused effort is needed to foster a "total quality" philosophy, which seems to have been neglected.

Willingness To Change: Transformation Through Innovation And Risk-Taking

This session explored the challenges of encouraging people to take risks and embrace new ways of interacting and working. George Roth from MIT presented a framework for learning and change that included the use of force field analysis as an exercise for developing common insights into the presentations during the session. Russ Hansen from Raytheon shared his experience of bringing multiple stakeholders together to develop a new contracting relationship in "Thinking 'Outside the Box' to Streamline Contract Execution". He was followed by Maj Chris Forseth from SAF/AQI presenting his research on "The Search for USAF Acquisition Intrapreneurs", which included insights into which individuals and communities are and are not relatively inclined to take risks in acquisition. A team presentation followed where Roy Moore and Jim Beardon from the IAM and Bill Whitley and Charles Wetmore from Boeing discussed the Quality Through Training and Return to Work Programs that involve a joint partnership between Boeing and the IAM to provide, among other things, innovative new training at the point of work. George Roth from MIT concluded the session with summary comments and observations from each of the presentations. Each of the case studies presented involved a "burning platform" or

significant threat involving survival anxiety. This anxiety was overcome through creative partnering, in some cases patterned after prior successful experiences. Other examples discussed ways of reducing learning anxiety by creating more comfortable contexts for experimentation. The force field analysis exercise illustrated how sources of learning and survival anxiety could be identified and addressed to enable transformation.

Creative Approaches To Learning Lean

This session featured three presentations and a panel session. Charlie Scheffer of The Boeing Company started off with a fast-paced presentation of how to teach an entire enterprise lean with simple exercises, following a just-in-time strategy. Hugh McManus described the LAI Lean Enterprise Business Simulation Game and how it uses a sophisticated Lego simulation to teach advanced lean lessons of enterprise integration. Peggy Holly of The Boeing Company built on Hugh's presentation by describing how Boeing IDS has taken the LAI game and incorporated it into their Lean Engineering training. The LAI Educational Network was introduced through a panel moderated by Dick Lewis of Rolls-Royce Corporation, including Earl Murman of MIT, Alex Miller of the University of Tennessee, Ed Borbely of the University of Michigan, and Lt. Col. Steve Brown of the Defense Acquisition University. Each participant presented approaches their schools are taking to including lean in their educational programs. These approaches included modules in core curriculum, research, on-line programs, executive programs, and certificate programs.

Aligning Supplier Value Streams

The session, offering multiple perspectives and methods on aligning supplier value streams, featured five presentations. The first, given by Prof. Alex Miller (University of Tennessee, Knoxville) and entitled "Supplier Integration at the Headwaters of the Value Stream," highlighted the potential benefits of greater supplier integration at the lower-tier levels through the creation of "mini-integrators" that would provide "solutions" rather than "commodities" to downstream customer companies (i.e., major suppliers and system integrators) by reducing transaction costs and improving the flow of components through the supplier value stream.

The next presentation by John Eash (The Boeing company) and Dr. Mitchell Fleischer (ALTARUM), entitled "Supplier Development Using a Value Stream mapping Approach," concentrated on the use of value stream mapping (VSM) approach in the context of the F/A-18 E/F program, focusing on the nose landing gear. The VSM approach encompassed the entire supply chain linking lower-tier suppliers to the prime, leading to significant reduction in lead time and cost for the landing gear, a critical-path item to meet the customer's lead time target in producing the aircraft.

In her talk entitled "Aligning Value Streams to Optimize Supplier Network Performance," Susan Moehring (TechSolve, Inc.) discussed a number of tools for aligning supplier value streams and gave concrete examples. She highlighted, in particular, the use of eVSM, an electronic value stream mapping creation and management tool built on MS Visio 2002

platform, as a method for managing data and information for value stream performance improvement.

Prof. Shahrukh Irani (Ohio State Univ.), in his presentation entitled "Value Network Mapping (VNM): Visualization and Analysis of Multiple Interacting Value Streams in Jobshops," introduced the Value Network Mapping (VSM) approach, a computerized tool using a software package for material flow analysis (PFAST -- Production Flow Analysis and Simplification Toolkit), to map the complete network of flows for a complex product or sample of parts. The analytical goal is to integrate the material flow mapping power of PFAST with the Finite Capacity Scheduling (FCS) power of PREACTOR, another tool used for analyzing the impact of scheduling delays on final product completion time when multiple components and subassemblies use capacity-constrained resources.

The final presentation by Dr. Rod Pipinich and Del Winn (Lockheed Martin Aeronautics), entitled "F/A-22 Raptor Value Chain Management," detailed the use of the VSM approach to reduce the lead time associated with the production of the rudder actual housing, a critical-path item in assembling the F/A-22 Raptor. The VSM approach enabled the reduction of the lead time from 55.3 days to 25.9 days.

Spiral Development Theory And Practice

Spiral development is an exciting new area of practice, and emerging lessons learned were discussed during "Spiral Development: Theory and Practice" on March 26 2003 at the LAI Plenary workshop. Many new questions also emerged during the course of the session. The discussion started with a summary of "Evolutionary product development strategies" by Bobak Ferdowsi of MIT. The current state of practice in spiral development was addressed by a panel comprising Dr. Beryl Harmon from DAU, Ms. Tina James from SAF/ACE, CDR Rick McQueen from the Globalhawk SPO, and Lt. Tim Spaulding from MIT/Harvard. The panel discussion identified both challenges and progress in implementing evolutionary acquisition. Some significant lessons that emerged include that spiral development is a management- and resource-intensive process, and that lean principles and process maturity are important to enable effective spiral development without increases in new resources; that there are many stakeholders that are involved in the acquisition process and that they may fear the types of changes from familiar procedures required by spiral development; and that existing acquisition infrastructure, including significantly the budgeting process, is designed around a traditional linear waterfall acquisition process and may inhibit evolutionary acquisition. The discussion then shifted to practices to enable more effective evolutionary development. Jeremy Tondreault from BAE Systems presented a model for "Iterating development to produce affordable military avionics systems" that demonstrated the choices that need to be made depending on the desired outcomes of the program. Then, Lt. Col. Rob Dare from ESC/AE presented his recently concluded research on "Collaborative Requirements Development". His study found that programs that used system representations (e.g., prototypes, beta software builds, etc.) to engage users and SPO representatives in knowledge sharing were more effective in generating value-adding collaborative requirements.

Enabling Value To Multiple Stakeholders

This session focused on examples where practices were used to enable and support lean concepts. Our first presentation was from Jay Mandelbaum (OSD) and Jim Vickers (Raytheon) who talked about how value engineering could be used to create a win-win scenario for sharing benefits of lean improvements over a period of up to 5 years. Jay emphasized that the sharing nature of value engineering is a lean practice in action. Jim discussed a number of cases that were examples of how value engineering was used to perform lean improvements where both the government customer and Raytheon were able to share in the savings from the improvements. Jim also told the session about a new DFAR change soon to be released for public comment that would expand improvement opportunities beyond specific contracts. This new DFAR change will allow facility wide lean improvements to be completed with the benefits shared as an increase to the overhead rate (however it is not applied for contract bidding).

Terri Anderson of Rolls Royce told us how she was able to improve the cash collection process. By defining the roles of team and expectations in dealing with business units and redesigning the cash collection process, Terri was able to engage, train and empower people in the process while being able to establish performance metrics to monitor progress. One of the keys was a priority system for active customer contact and a dispute resolution process. One of the enablers for these cash collection process improvements was utilizing the features of the recently installed SAP system. From this disciplined process, outstanding cash to be collected was reduced and disputes were resolved faster.

Aprille Lucero and Clint Winterling of Lockheed Martin Space and Strategic Missiles told us about other beyond the factory floor lean enablers that foster teamwork, commitment and engagement of the extended team. Aprille showed several cases where training was used to engage change agent teams that spanned the contractor and customer fostering a shared commitment and sustained changes. In another case, training was used as a reward mechanism. The customer, seeking to reduce risk in this concluding program, encouraged retention of valuable human resources by offering Green and Black Belt training. Not only did people get valuable, marketable skills but the program experienced many improvements to transactional processes which helped mitigate program risk. Recognizing that much of the value of products comes from suppliers, Clint Winterling presented a case where the building of positive supplier relationships enabled nonconformance reductions, joint initiatives that improved interface processes, and enabled further supplier lean efforts through education and training.

22-25 Mar 04: La Jolla, CA

The Lean Aerospace Initiative consortium convened its annual conference at Dana Point, CA on March 23 and 24, 2004. The conference sought to explore the enterprise transformation challenges facing the consortium. In the first days' general session Prof. Deborah Nightingale convened the conference by sharing with the attendees the LAI consortium's role in enterprise transformation by reviewing efforts ongoing from all consortium stakeholders in

the past year. Keynote speakers from the Army, Navy and Air Force shared their thoughts on transformation efforts on-going in their services. Maj Gen N. Ross Thompson of the US Army representing Gen Kern talked about the transformation efforts being lead by the US Army in general and the US Army Materiel Command in particular with information about their enterprise excellence progress and plans. Dr. Thaddeus H. Sandford from Boeing Integrated Defense Systems talked about their enterprise transformation following various consolidations and the integration of numerous initiatives into common themes. Rear Admiral Michael C. Bachmann talked about Naval Aviation's transformation initiative, AIRSpeed as a means to focus value to the warfighter using lean, six sigma and theory of constraint tools to enable cost-wise readiness across the naval aviation enterprise. Representing Gen Martin, Dr. J. Daniel Stewart talked about past accomplishments at the US Air Force Materiel Command and the future direction of their transformation and restructuring efforts. On the second day of the conference, an executive panel session was convened where Maj Gen Kevin J. Sullivan from the Ogden Air Logistics Center, Lisa Kohl from Northrop Grumman Space Technology, Thomas A. Pinski from the International Association of Machinists and Aerospace Workers, Christopher B. Cool from Northrop Grumman, and Col William A. Guinn from the Letterkenny Army Depot each talked about their enterprise transformation efforts. At the conclusion of this session each shared their top lessons learned while undergoing their enterprise transformation.

All briefings, including the ones missing from the Plenary Conference CD will be posted on the LAI website (<http://lean.mit.edu>).

BREAKOUT SESSIONS

Enterprise Transformation: Approaches and Enablers

(Session Leader: Dr. Kirkor Bozdogan)

The session focused on key approaches and enablers for successful enterprise transformation, such accelerating the process of enterprise transformation through knowledge transfer, as effective approaches to managing people and processes, and successful coaching strategies for those actively engaged in enterprise transformation. Three presentations directly addressed these topics. The first, "Enterprise Transformation through Knowledge Transfer" by Bill Baker (Raytheon Systems), described the knowledge management system at Raytheon, which is integrated with Raytheon's six sigma enterprise change process. The next presentation, "Approaches to Managing People and Processes" by Fred Payne (BAE Systems), stressed the importance of finding the right mix of style between creativity and structured processes in managing people as an integral part of a successful lifecycle project management system. The final presentation, "Coaching Strategies for Lean Implementation," by Lt Col Steve Brown (USAF) and Lt Col Scott Miller (USAF), concentrated on the importance of developing robust coaching strategies for successful lean deployment, based on an investigation of coaching methods and approaches employed in a wide variety of enterprises. The panel discussion following the three presentations covered a number of issues, such as approaches for resolving the inherent conflict between creativity and structure, transferring tacit knowledge into explicit knowledge, and under what conditions different coaching strategies might be most effective.

Infrastructure Systems for Enterprise Transformation

(Session Leader: J. Tom Shields)

This breakout session focused on those efforts and systems that enable enterprise transformation. Victoria Werman from Lockheed Martin shared her perspectives about enabling transformation by structuring the transformation efforts in such a way as to facilitate buy-in by infrastructure elements. Aprille Lucero also from Lockheed Martin stimulated our thinking about the breadth of transformation efforts by challenging us to consider infrastructure systems that support transformation efforts not from just a program perspective but a multi-program and even a national/international perspective. After these framing presentations we had two presentations that focused on specific infrastructure systems that could support transformation. Tom Shaw from the Government Electronics and Information Technology Association (GEIA) and Greg Ferre from MIT talked about their findings in an assessment effort requested by the Defense Contract Management Agency (DCMA). This assessment provided an assessment of lean in the aerospace and defense industry and an assessment of IT infrastructure. Following this presentation, Dr. Glenn Parry from the UK LAI talked about implementation and maintenance of ERP systems in a lean environment from their research efforts in the UK.

Industry-Government Infrastructure; Extending Lean Processes

(Sessions Leader: Dr. George Roth)

The Lean Success breakout session Tuesday afternoon heard from a variety of programs in a variety of contexts implementing Lean changes. Dr. Ed Kraft, discussed the learning process in building a Government-Industry Lean process with the additional complication of Joint Service (Army-Navy-Air Force) participation. His talk stressed the high payoff of data gathering in preparation for Value Stream Mapping events. Major Ron Jobo of the Global Hawk Program Office reviewed successes, challenges, perceptions and misperceptions of Lean Now in a government-contractor partnership. Ron highlighted what became a recurring theme of these sessions: initial impetus for Lean comes from 'top down' direction generating 'tactical action' in the form of Lean initiatives. These early tactical successes, however, must be supported quickly by a strategic infrastructure and policy deployment plan that helps Lean take root for the long haul. Next, George Roth of LAI used the model of corporate-university partnerships to facilitate a discussion of Government-Industry partnerships. The second half of the session provided windows into two success stories: Boeing St. Louis JDAM production, presented by Ms. Karen Darrow and Fleet Ballistic Missile System Program Support, presented by Capt Steve Lewia and Mr. Richard Williams of Lockheed Martin Space Systems. The Boeing story is one of dramatic production surge (a factor of four!) through disciplined application of Lean and numerous other process improvement/quality methods over a two-year span. The FBM program story is one of using lean and other process improvement methods to cope with tectonic shifts in strategic context (the end of the Cold War) while still maintaining flawless technical performance and program morale. These two discussions brought out another common theme: the indispensable need to bring all relevant stakeholders together as full team partners, to build robust communication channels and use them for information dissemination. By putting this infrastructure in place, it is possible to achieve shared expectations, reduce anxieties and concerns among all parties, whether labor, government, management, supplier or other key stakeholder. Ray Peters ended the session discussing physical information infrastructure to support Lean with a

presentation on F/A-22 producibility and affordability, stressing the value of decentralized decision making once local decision makers had relevant information at their disposal.

Revitalizing Systems Engineering

(Session Leader: Dr. Donna Rhodes)

The US Air Force and the Department of Defense have recently issued new policies and guidance on Systems Engineering, as well as established initiatives to ensure its revitalization and effective application in defense programs. Additionally, Dr. Marvin Sambur, Assistant Secretary of the Air Force for Acquisition, has requested that LAI assist in these efforts to revitalize Systems Engineering. The breakout session on Revitalizing Systems Engineering was structured to inform the LAI community about policy changes, guidance, and initiatives related to the revitalization of Systems Engineering in government and industry. Government speakers included Mrs. Marty Evans, Director, SAF Acquisition Center of Excellence; Mr. Mark Schaeffer, Director of Systems Engineering for OSD AT&L; and Mr. Mark K. Wilson, Director of AF Center for Systems Engineering at AFIT. Several industry leaders overviewed and discussed how their organizations are responding to the revitalization effort, and how they are addressing the need for effective systems engineering in the face of growing complexity and technological challenges. Speakers included Mr. Joe Adams, VP of Engineering at Pratt & Whitney; Mr. Dennis Schwarz, Director- Product Processes & Tools for AF Programs at Boeing IDS; and Mr. Steve Tyley, Site Manager of Lockheed Martin Sunnyvale and Deputy SE Director for LM Space Systems Company.

Enterprise Transformation: Perspectives and Experiences

(Session Leader: Dr. Kirkor Bozdogan)

The session highlighted lessons learned and success factors in enterprise transformation, based on actual experiences involving large-scale enterprise change in both aerospace and other industries. Four presentations covered various key dimensions of enterprise transformation. The first, "Lean Transformation Perspectives" by Ralph Bernstein (Productivity Press), reviewed the transformational experiences a broad sample of enterprises in diverse industries where successful change was made possible by taking an aggressive "do it all, do it now" strategy covering as much of the enterprise as possible. The second, "Process-Focused Enterprise Transformation: Some Lessons Learned" by Dane Rasmussen (Northrop Grumman Integrated Systems), emphasized the importance of developing controlled and repeatable processes based on a process architecture and focusing on the customer as a necessary condition for enterprise transformation. The third presentation, "Measures and Incentives" by Dr. Cory Hallam (Northrop Grumman Integrated Systems), stressed the importance of metrics and incentives in driving enterprise transformation, as well as tracking progress, within the larger context of anticipating and planning for complex causal links characterizing enterprise change processes. The final presentation, "Enterprise Transformation Process Engaging Suppliers" by Susan Moehring (TechSolve, Inc.), illustrated through specific examples the importance of a structured approach to transforming extended enterprises encompassing suppliers, where leadership working in concert across the entire value stream, within a collaborative environment, is critical to successful enterprise transformation. The panel discussion following the presentations addressed such issues as "big bang" vs. "gradual" strategies, how to think about complexity in enterprise change, the need for collaborative initiatives to transform the larger US aerospace enterprise in light of

the common multi-tiered supplier base supporting many aerospace primes and major suppliers.

Lean In Government Enterprise Success; Process and Approaches for Lean Success

(Sessions Leader: Dr. George Roth)

The Lean Success breakout session featured seven presentations under two topics. Gregg Beecher from Warner Robbins ALC kicked off the "Lean in Government Enterprise Success" section. Gregg's talk described how Lean efforts at the ALC got off to an uncoordinated start in 1999. Since then the events have improved dramatically with better integration, continuing support, and measurable results. Anthony Dunn and John Dickmann added details about the dramatic improvement in C-5 and C-130 depot maintenance at the ALC. Lydia Fraile followed with a description of union cooperation and contributions to the initiatives. Jessica Cohen concluded the topic with a talk on efforts to apply Lean to administrative functions such as purchasing. In the second section of the breakout session, "Process and Approaches for Lean Success", a team from Lockheed Martin described their methods for implementing lean on a large sophisticated program that spans multiple organizations, the F/A-22 Raptor. Dean Westcott from Northrop Grumman followed with a talk on the success of Lean at the Redondo Beach facility where the engineering - centric culture is skeptical of process oriented initiatives. The last talk was presented by Jerell Smith from Boeing, who offered insights into what really makes the Toyota production system a success: a culture that encourages experimentation and continual improvement. The breakout concluded with a lively discussion session lead by George Roth. Questions and comments were still flying when the time ran out, a testament to the interesting and informative presentations.

Individual, Team and Organizational Learning

(Session Leader: Alexis Stanke)

This break out session began with small group table discussions of what learning means, and what learning means for individuals, teams, and organizations. Alexis Stanke of MIT presented the Lean Academy™ course which focused on industry-academia collaboration between LAI and EdNet members to provide training to both faculty as instructors and new hires, co-op and intern students. The discussion primarily focused on the impact this course will have on faculty at schools in the EdNet. The second presentation was by Henrik Bresman of MIT, who talked about team learning strategies, especially "vicarious learning". He presented a comparison of findings in the pharmaceutical industry with findings from LAI members. The discussion focused on how to increase the speed of learning within teams. The final two presentations were by Barb Sande and Sandy Miller of Lockheed Martin. In the context of the Titan and Atlas programs respectively, they presented the integration of the corporate LM21 improvement program. By using LM21 tools and training courses, the Titan program has retained its workforce and significantly reduced risk as the program nears its end with the final Titan launch. The Atlas program has successfully integrated its extended enterprise by sharing LM21 concepts and tools with its customers and suppliers. The discussion following these presentations focused on how standard programs, like LM21, can facilitate organizational learning.

22-24 Mar 05: La Jolla, CA

This year's annual LAI Plenary Conference, whose theme was "Lean Enterprise Transformation: Building the Infrastructure", was a marked success on all fronts, and set a new attendance record in the process.

Detailed information on the Plenary Conference may be found on the LAI Web site at <http://lean.mit.edu>. In addition, the following recaps of the Plenary Conference itself as well as its affiliated meetings and specific breakout sessions are offered below.

2005 LAI Plenary Conference Wrap-Up

The 2005 LAI Plenary Conference is now in the books and the reviews are most positive. A record attendance of more than 250 people was set, with LAI members and other attendees from industry and government, from as far away as South Korea, gathered at the Laguna Cliffs Marriott in Dana Point, California for two days of networking and learning.

In his closing remarks to the Conference on Thursday, March 24, Professor John Carroll summed up its chief accomplishments:

- We shared stories of progress, impact, insights, lessons learned, principles, problems, plans, and prospects for the future.
- We continued to build a learning community and network of resources bridging across government, industry, and academia.
- We challenged ourselves to dream big: from local projects to national and global enterprises, from operational to strategic, from customers to stakeholders, from aerospace to health care.
- We had fun!

Keynote speaker Bob Conner, executive director of AFMC, captured the essence of the Conference's theme - Enterprise Transformation: Building the Infrastructure - in his discussion of the transformation of the AFMC when he said, "It's tough to transform without changing." For two days, Conference attendees learned and talked about the challenges of enterprise change and the building blocks needed to facilitate and sustain it.

In keynote speeches, panel discussions and breakout sessions following Mr. Conner's remarks, Conference attendees learned about the elements necessary for a successful transformation from people who had been there and done that.

They shared their practical experiences and research findings from the perspectives of government programs, industry and academia. The keys, they all agreed, were shared language and definitions; trustful relationships and connecting people to the process; focusing on valued results and equitable incentives; leadership support and participation; in-house expertise (Jan Klein's "insider outsiders"); and cultures that support openness and teamwork.

The overall take away from the 2005 Plenary Conference can best be summarized by the four challenges that Dr. Carroll identified as key outcomes from the Conference.

- Challenge 1: take action with partial planning - spiral development of lean thinking
- Challenge 2: standardize tasks and processes, but in ways that encourage innovation - lean is a verb...a way of thinking, not just tools
- Challenge 3: definition of the enterprise is crucial, but difficult - it is more about value and stakeholder relationships than about control
- Challenge 4: patience is essential - the business case is ultimately based on faith (the measures and numbers come later)

LAI Product Lifecycle Knowledge Area Meeting

Participants in the LAI Product Lifecycle Knowledge Area held a meeting on March 22, prior to the formal start of the LAI Plenary Conference. The intent of the meeting was to discuss and review recent developments in the LAI product lifecycle knowledge area, including research, products, and improvement events.

Research discussions included discussion of work on systems engineering, lean product development, and systems architecting. There was also discussion of several LAI products that focus on product development that have been deployed to the consortium since the group previously met.

Eric Rebentisch from MIT/LAI presented an overview of on-going and proposed research in the product lifecycle domain, including PD practices and tools, system lifecycle management, and system architecting. Donna Rhodes from MIT/LAI presented an update on the recent work LAI consortium members have been involved in to develop systems engineering tools and products, as well as discuss on-going and emerging systems engineering-related research. This includes reports of activities in support of the USAF systems engineering revitalization efforts, the recently-formed SE Research Group at MIT, continuing meetings of the LAI Educational Network Lean SE group, LAI research papers and panel session presentations at six recent conferences, the emerging development of a new LAI product to supplement CMMI and LESAT, and SE- focused collaborations with the USAF Center for SE, FFRDCs, Consortia, and Industry Associations. Hugh McManus of Metis Design spoke about his on- going work for the LAI consortium to develop products and tools for transforming lean product development. These include the PDVSM and PDTTL manuals, the report of the Space Systems Policy and Architecting Research Consortium (SSPARC), and lean engineering training using the LAI Lean Enterprise Value simulation. All of these tools are available for use by LAI consortium members, and many are currently available for download on the LAI Web site.

Eric Rebentisch also gave an overview of his involvement in the on-going MIT/Draper Lab Constellation Systems/Crew Exploration Vehicle study for NASA. This study is just beginning its second six-month study period with the objective of clarifying objectives and requirements for the current US space exploration initiative focused on returning manned expeditions to the moon and Mars. This study promises the potential development of stakeholder analysis and multi-stakeholder utility tools (potentially applicable to system of systems architecting and prioritizing objectives for large-scale systems), enterprise architecting methods/analytical frameworks refined through application, additional LAI experience with large-scale enterprise transition strategy and action plan tools and techniques

development/refinement, as well as documentation of the system of system trade study methods currently being developed and applied. Victor Tang of MIT presented an overview of his research on developing decision-making tools, with an overall objective to help enable executives to make good decisions by effective exploration of the decision and solution spaces using engineering methods (particularly, design of experiments, or DOE.) Josef Oehmen and Jin Kato of MIT presented an overview of several research projects focused on defining value and waste in product development. This includes the development of a framework identifying 40 different forms of waste and waste drivers in PD processes, and value stream mapping work at MIT and at industrial sites to measure waste and value creation in PD processes and validate the framework. The intent is to use this knowledge to develop better tools and practices for planning and managing product development efforts. Erisa Hines of MIT/LAI concluded the session with a discussion of the emerging findings from her study of information tools in PD, primarily in the form of product data management (PDM) systems. The group also discussed the recent request to the LAI Champions to collect practices and metrics related to design-in-process quality. The intent of the request is to identify practices and leading indicators that enable product developers to better assess eventual product quality and function before it proceeds to system test, and respond with appropriate interventions to correct discrepancies as necessary. The knowledge area community agreed to participate in the response to this request.

Performance Measurement Frontiers Breakout Session

The session on Performance Measurement Frontiers covered three talks, followed by a moderated group discussion. The first talk, "Designing a Lean Enterprise Performance Measurement System" by Vikram Mahidhar of MIT, identified the key limitations of current performance measurement systems, from the perspective of transitioning from a functional enterprise to a process enterprise. The talk further highlighted the need to align the enterprise behavior to the enterprise value proposition (across stakeholder needs, enterprise strategic objectives and operations), through the use of a system of metrics that can be measured both across and within the enterprise value stream. A conceptual model of the performance measurement system, in terms of individual metrics, metric sets and metric clusters was presented, followed by the data collection and analysis approach.

The second talk, "Aligning Performance Measures and Incentives to Transform Sustainment of Defense Systems" by Steve Brown of DAU, addressed the three questions of when, where, and who should apply lean in the defense support environment. The talk highlighted the need for revisiting the acquisition framework to incorporate life cycle management through the use of incentives in contracts, as well as specific support performance metrics such as availability, reliability, cost per unit usage, logistics footprint and logistics response time. Five case studies involving cost plus, fixed price, and firm fixed price contracts were discussed, and the impact on specific performance incentives and disincentives were detailed.

The third talk, "A Lean Cost Management and Accounting Infrastructure for Aerospace Enterprises", by Yvonne Ward of UK-LAI, motivated the need for change in traditional cost and managerial accounting. The talk highlighted the mismatch between the behaviors promoted by lean enterprises, and those promoted by traditional cost accounting, and how metrics such as machine utilization and labor productivity drive non-lean behavior. The

research was carried out in a two-phased format, addressing lean accounting followed by costing and accounting for lean. The results at the end of both phases were presented, along with the findings at the end of each phase. The major recommendations were to include using a balanced set of measures, embracing life cycle costing and analysis, and revising management accounting education and training.

The final group discussion was moderated by Jayakanth "JK" Srinivasan and George Roth, both of MIT. The discussion surrounded three topical areas: challenges in balance scorecard implementation, the need for reforming management accounting, and the challenges of implementing appropriate incentives to drive transformation. Lean transformation does not reflect immediately on the enterprise bottom line, and the appropriate metrics need to be designed to accurately reflect the capabilities derived through the implementation of lean principles and practices. The flaws of the balanced scorecard are in the implementation of the metrics system, which drives local optimization of individual metrics by line managers as opposed to system level optimization. The implementation of lean accounting allows lean to be applied in non-traditional areas, thereby increasing buy-in to the use of lean concepts, even if traditional financial metrics do not reflect gains through the use of lean concepts. Lastly, the need for the acquisition community (both government and industry) to create, align, and manage performance incentives across the entire lifecycle of the system was discussed.

Change Methodology, Planning & Standardization I Breakout Session

This session focused on a number of related topics in building an infrastructure for lean enterprise transformation, such as structured approaches and planning methods; implementation tools; frameworks and techniques for managing interdependencies; and standardized systems, processes and practices. Four speakers addressed these topics. The first presentation, "Lean Enterprise Transformation: Ogden ALC Case Study", by Tim Christopherson of Raytheon Missile Systems and Alexis Stanke of MIT, gave an account of the alpha-testing of the lean Enterprise Value Stream Mapping and Analysis tool, which was used in conjunction with other LAI-generated enterprise-level tools to develop and deploy the lean enterprise transformation strategy at the Ogden Air Logistics Center. The next presentation, "Implementing Lean Enterprise Transformation in the Complex Environment of Healthcare: Lessons Learned in the First Eighteen Months", by Dr. Roger Gerard of ThedaCare and Marc Hafer of Simpler Consulting, concentrated on the implementation of lean principles to bring about fundamental enterprise change in the health care delivery industry. The third presentation, by George Shinkle of Direction Associates, "Management Systems Diagramming: Moving Toward a Lean Management System", illustrated the application of structured frameworks and methods for lean management to align enterprise strategies and processes. The final presentation, by Dale Moore of NAVAIR, "Naval Aviation Enterprise AIRSpeed Deployment and Implementation", provided a description of the progress made in transforming naval aviation operations by employing lean principles and methods to provide cost-wise readiness and dominant maritime combat power. These presentations, and the ensuing group discussion, underscored the importance of evolving the necessary enabling infrastructure systems, structured methods and processes to achieve successful enterprise transformation.

Identifying, Training and Empowering Change Agents Breakout Session

This was a dynamic session that featured two approaches to a change agent structure, one presentation of the use of simulation to assist in training enterprise lean concepts, and one presentation on a change agent's personal perspective. Marywayne Bush talked about Lockheed Martin's corporate structure supporting its LM21 program through the eyes of its training program. Karen Darrow and Liz Cange talked about Boeing's change agent infrastructure and the value of an informal network of change agents helping throughout Boeing's divisions. Alok Verma from Old Dominion University talked about a simulation developed to help train people in the ship building/repair industry on lean enterprise concepts. Finally, Pat Gibson of Boeing talked about his experiences as a change agent.

To conclude this session, we explored change agent infrastructure characteristics that lead to successful engagement, training and sustaining systems for enterprise transformation. The results of this effort were:

- develop a structure to support training and resources
- develop methods that reduce risk aversion (learn from failures vs. punish)
- develop rotation programs
- provide for a community among the change agents
- standardize training, provide extended OJT and leadership training
- develop a good process for using change agents
- provide for a higher level "non-partisan" receptive group to listen to lower-level change agents and champion their ideas
- build on success from multiple sites (*e.g.*, visiting speakers)
- build in provisions for the infrastructure to change
- provide a career path plan
- incorporate open-mindedness in recruitment activities to find non-typical potential employees as change agents
- provide training that is timely and pertinent to different types of change
- agents (engineering vs. finance vs. other functions)
- provide compensation/rewards on multiple levels
- develop union/employee engagement to create willingness to listen to/work with change agents
- develop partnerships with unions, make sure goals are aligned
- develop creative ways to garner employee buy-in and/or discourage nay-saying

Aligning Across Functions Breakout Session

The LAI Plenary breakout session *Aligning Across Functions* addressed the dilemma for enterprise leaders of how to integrate activity, knowledge, and processes across traditional functional and organizational boundaries, as well as new approaches to operating, new coordination mechanisms, and new organizational structures and forms. Robert Herndon from TASC/Northrop Grumman began the session with his presentation "SWEPT Away: Applying CMMI in an Operational Environment" discussing the application of CMMI and Integrated Systems Engineering (ISE) frameworks to develop common processes and systems at a large-scale military operational site that encompasses multiple users, contractors, and facilities. He discussed the challenges the team faced, as well as lessons

learned through implementation. Courtney Weiss of Boeing IDS next spoke about the "LSI Approach to Systems of Systems Lean Development & Production Readiness" that Boeing is using in its lead systems integrator role for the US Army's Future Combat System (FCS.) FCS is a program of enormous scope and has demanded the use of a large variety of different integrating mechanisms, as well as innovations in approach to system management.

The group heard from the Raptor Lean Team from the F/A-22 program enterprise, consisting of Don Handell and Randle Wright from Lockheed Martin, Kathi Treiber from Boeing, Ida Gall from Pratt & Whitney, and Greg Staley from the USAF F/A-22 system program office. Their topic was "F-22 Cost Reduction Task Force: Key to Raptor Affordability." Through the work of the CRTF team, the program has made significant progress in reducing the cost of delivered aircraft and meeting a user's needed number of aircraft in a cost-capped program. Aaron Taylor from MIT discussed his research in the "Impact of Knowledge Management Tools as Integrating Mechanisms". He specifically presented a case study of the benefits of implementation of knowledge management tools in the Navy's DD(X) program. He described a method he developed using lean concepts to estimate the ROI from knowledge management tools. The session concluded with a talk by April Wicker of Rockwell Collins on the "Impact of Language on Cross-Functional Alignment." She studied how specific lean terms and the language used in training engineers to apply lean in engineering affected their mental models, and concluded that the processes used in engineering were sufficiently different from those in manufacturing that translating manufacturing lean concepts to engineering terms alone was not sufficient to overcome engineers' inclinations to apply lean principles to engineering processes. The presentations from this session are available on the LAI Web site.

Designing Support Structures and Processes Breakout Session

This session covered three talks and was followed by a moderated group discussion. The first talk, "Enabling Enterprise Transformation through IT: The PDM Example" by Erisa Hines of MIT, identified the needs of the aerospace industry with respect to product data management, and discussed the challenges associated with implementing systems that manage product data across the entire lifecycle. The talk highlighted the current state of PDM systems within the industry and contrasted the current state to the ideal state, *i.e.*, a lean enterprise where data is managed across the entire lifecycle, and the resultant ability of the enterprise to create agility and capabilities. Two key findings based on the survey were the expenditure involved in developing PDM systems, and where capabilities for implementing PDM systems existed in the aerospace industry. A major portion of the expenditure of PDM systems resides in process development and infrastructure costs. However, one of the research findings was the need to invest more in process development, and thereby enable enterprise transformation. The capabilities for implementing PDM systems currently resides in the primes, and given that primes are migrating to large-scale systems integration, there is an urgent need for developing data management capability in the supply base.

The second talk, "The Rotorcraft PDM Story", by John Scott of the Boeing Company, discussed the challenges associated with implementing a PDM system within a single site, and migrating the knowledge and lessons learnt across an entire enterprise. The talk highlighted the need for strong leadership through the "frogs and hedgehogs" analogy, *i.e.*, a

leader who does not recognize that a project is impossible, and also has the capability of defending both the project and the team from the constant pressure of having to show results. There were three key take-aways from the talk: the need for "big bang" migration to prevent pockets of persistent resistance within the enterprise; the need to scrub data prior to migration, as incorrect/ambiguous data will cost much more downstream when a new system is in place; the need to define the processes and tailoring an off-the-shelf system during implemented to prevent the IT system from defining the processes for the user.

The discussions from both talks brought to surface the need of the aerospace industry to advance product lifecycle management knowledge and practices. While the automotive world currently has the largest segment of the product lifecycle management market, data management within that sector extends at best to the supply chain. The aerospace industry, on the other hand, requires product data to flow across the entire lifecycle from internal customers, such as manufacturing and procurement, to end users such as the depots and flight line maintenance.

The third talk, "Lean Manufacturing Infrastructure for the C-5 Modernization Program", by Chad Jones of Lockheed Martin Aeronautics, discussed the needs of small programs with respect to implementing lean. The talk highlighted the need to involve domain experts both internal and external early in the lifecycle, and detailed the mechanisms adopted within the C-5 modernization program.

The group discussion, moderated by Jayakanth "JK" Srinivasan of MIT, Discussed the role of IT in enterprise transformation. The discussion brought forth disparate mental models within the aerospace community on the role and usage of IT. The dominant takeaways from the discussion were the need to define processes before implementing an IT system, the necessity of defining the space within which a system operates (enterprise level, strategic level or operational level), and identifying the alignment across multiple IT systems present within an enterprise. The only guaranteed cost savings associated with implementing a new IT system is the ability to take legacy systems offline. This, however, involves significant investment by the enterprise, far exceeding the life support costs associated with sustaining legacy systems. The true benefit of a new IT system is realized through process harmonization and data standardization, which are preventive measures that result in immediate intangible savings, and possibly quantifiable long-term benefits.

Change Methodology, Planning & Standardization II Breakout Session

This session focused on a number of related topics in building the infrastructure for lean enterprise transformation, such as structured approaches and planning methods; implementation tools; frameworks and techniques for managing interdependencies; and standardized systems, processes and practices. Four speakers addressed these topics. The first presentation, "Developing a Future Lean Vision Using Enterprise Value Stream Mapping and Analysis (EVSMA)", by Erika Jackson-Scott of the USAF, Mark Lindquist of Boeing, and Stephen Jacobs of the DCMA, provided a detailed description of the beta-testing application of the EVSMA tool to help transform the C-17 program enterprise. This was followed by a presentation by Dr. Hugh McManus of MIT/METIS and Geoffrey Bentley of Textron Systems, "Textron Sensor Fuzed Weapon Value Stream Mapping Event: Using LAI Tools to

Transform a Program Enterprise”, highlighting the use of the enterprise simulation game experience as a unique learning event providing insights into enterprise-level interdependencies linking together multiple processes and functions. The third presentation, by Chris Smith of Raytheon, "Lean Implementation to Achieve Early Results", showcased the application of lean principles to achieve significant operational improvements in Raytheon's microwave advanced manufacturing operations. The final presentation was by Jim Brice of NAVSEA and Bob Kelly of Northrop Grumman, "The Naval Sea Command Commences Rollout of Lean Six Sigma", which concentrated on a comprehensive, enterprise-wide lean six sigma transformation of the Naval Sea Systems Command. These presentations, as well as the ensuing group discussion, further reinforced the importance of evolving the necessary enabling infrastructure systems, structured methods, and processes to the achievement of successful enterprise transformation.

Engaging People in Evolving a Lean Culture Breakout Session

With the understanding that enterprise transformation involves people as much, if not more, than it does lean tools and methods, this session explored ways in which organizations engaged their people to support transformation. Lynette Marling from Rockwell Collins shared their approach to knowledge management using an infrastructure of communities of practices (COP) that are used to not only retain current knowledge, but also accelerate the transfer of that knowledge to other employees. Karen Robinson of Boeing shared with the audience efforts to facilitate the move from directive type management practices to team-centric management approaches. Janet Riley of Boeing shared the important role of leadership to challenge and enable teams to embark on new approaches and enable success through team efforts. Finally, Jerrell Smith of Boeing used a medical case to emphasize infrastructure design aspects that could lead to latent problems, lost signals, and lost opportunities to fix small problems before they become disastrous.

Topics in Sustaining Lean Change Breakout Session

George Roth led a breakout session on the topic of sustaining and accelerating lean change, which was explored using three approaches. The first two used traditional presentation methodology, while the third approach, called "open space", provided a unique and highly participative way to discuss salient issues with the session's participants.

First, George provided context by presenting on the history of LAI's knowledge areas, existing and emerging theories and frameworks for lean transformation, and five principles of what it takes to make lean enterprise change. He proposed and received strong support from working group members that the key persuasive orientation and primary question should be enterprise growth and lean acceleration as opposed to sustainment.

Second, three MIT graduate students presented their theses work. Vikram Mahidar illustrated how there is a substantial disconnect between financial, operational, and leadership measures within organizations and the critical need to connect these to achieve lean improvement and change at an enterprise level. Jessica Cohen's research asked how the capabilities, resources, and conceptual models embraced by ALC leadership teams affect lean enterprise transformation efforts, and identified enterprise transformation best practices at the ALCs. Justin Hemann's research suggested that system dynamics is a worldview and framework that

can help test our mental models and be a useful approach in conjunction with other complementary approaches for analyzing problems in complex enterprises.

Finally, George created an "open space" for working group participants to step back and reflect through sharing insights with each other. Colleagues clustered together based on their interest in discussing specific experiences, challenges, and ideas around enterprise change. Among the topics discussed were the development of a field book on enterprise transformation, and the reconsideration of lean enterprise "architecture" as the right and most useful model or metaphor.

Topics in Supply Chain Management Breakout Session

This session focused on several salient topics related to building lean supplier networks, including tools for designing and managing lean supplier networks; flowing lean to lower-tier suppliers; streamlining vertical interfaces in the supply chain; mapping enterprise value streams encompassing supplier networks; and the role of information technologies and systems in managing extended enterprises.

The first presentation, by Kirk Bozdogan of MIT, Hamid Akhbari of the USAF, and Chris Darden of Northrop Grumman, "Supplier Networks Working Group: Overview of Activities with Emphasis on the Lean Supply Chain Now Pilot Demonstration Project", provided a summary discussion of the group's activities related to the development of a tool set for building lean supplier networks and gave an overview of the group's current initiative focusing on pilot projects for streamlining vertical interfaces in the aerospace supply chain. The second presentation, by Susan Moehring of TechSolve, Inc., "Lean Thinking for Supply Chain Interfaces -- Opportunities, Examples and Challenges", outlined actual examples of key interface issues, highlighted some of the benefits that can be derived by streamlining vertical interfaces in the supply chain, and provided an overview of the opportunities for achieving significant further improvements. The third presentation, "Beginning the Lean Journey at Kaman Dayron", by Brad Campling of TechSolve, Inc., provided a case study discussion of the significant process improvements achieved in a build-to-print supplier setting through the implementation of lean principles and practices. The final presentation, by Steve McNamara of Northrop Grumman Mission Systems, "Using Scorecards to Improve Supplier Performance", described the supplier assessment and management framework and processes employed to ensure mission assurance and successful project execution resulting in customer satisfaction. These presentations underlined the importance of managing the interfaces in the supply chain, with particular focus on interfaces with lower-tier suppliers.

Topics on Lean Culture and Enterprise Capabilities Breakout Session

In this session there were presentations that covered several topical areas: change agent infrastructure, standard work for leaders, using quality and lean tools in everyday life, and a research report from the UK LAI on a two- year case study. Beth Barnickel from Northrop Grumman Mission Systems explored the transformation of that organization from a Six Sigma-centric approach to a lean six sigma approach, covering the infrastructure used to train and employ change agents. David Mann from Steelcase brought new ideas to the meeting with a talk about applying lean concepts and standard work to leaders and managers. Tim Clark from the Defense Finance and Accounting Service reminded us that lean and quality

knowledge is applicable in our personal lives as well as at work. Glenn Parry from the University of Warwick and the UK LAI showed how an enterprise analysis of its core competencies and the focus of lean efforts on these same competencies can lead to dramatic increases in market share.

Topics in Product Development Breakout Session

The LAI Plenary breakout session *Topics in Product Development* focused on how LAI consortium members are currently applying lean principles and practices to engineering and PD processes. In many ways, this meeting was a continuation of the meeting of the Product Lifecycle knowledge area held two days before, as it included many of the same participants. It also included discussion of improvement activities, tools, and lessons learned, in this case primarily from industry.

The first speaker was Kevin Naya from Boeing Space and Intelligence Systems, who spoke about "Starting a Journey in Lean Engineering" This lean journey in product development has included investment in training, education, and developing capability, making lean a leadership responsibility, instituting assessments to guide behavior, sharing successes to recognize and reward results, and communicate regularly. Steven Thompson and Gary Bergan from Boeing Integrated Defense Systems spoke on "It Doesn't Apply Here... or Does It? Lean Deployment for Product Development." They presented a model of lean in engineering that includes the need for fast, flexible and adaptive engineering processes, enabling rapid low-cost production, and value-focused product designs. The presentation of their journey included discussion of their focus on lean in the hand-offs and interface processes between these areas. Professor Bo Oppenheim from Loyola Marymount University presented an update on his "Lean Product Development Flow" model and its application in industrial development projects.

Deb Secor and Dean Bliss from Rockwell Collins discussed their on-going project on "Transforming the Enterprise Product Development Function", which encompasses the entire product development function at Rockwell Collins. This included not only a discussion of the development and use of LAI tools to assist in the process, but also their enterprise change process that includes senior leadership buy-in, benchmarking, value stream mapping, and the development of metrics. Ron Mascitelli from Technology Perspectives presented several case examples of introducing lean to product development, selected from his numerous interventions in organizations in a variety of industries. His presentation provided good insight into a number of different tools and how they have been applied in different settings, as well as long-term implementation lessons learned. Aprille Lucero from Lockheed Martin concluded the session presentations with her presentation of "Integrated Development of Software and System Test." She discussed a number of improvement projects focused on testing and software development during recent years and how an enterprise perspective was essential in making some key improvement gains.

The group discussed benchmarking the use of lean in PD, led by Deb Secor and Dean Bliss, who cited their recent experience in lean PD benchmarking. A number of the participants expressed either similar experience in experiencing difficulty in finding good practices or metrics benchmarks for lean PD, or interest in learning more about the area. A subgroup

(based on this interest) agreed to meet in the near future to hold a meeting devoted to benchmarking lean practices and metrics.

4. LAI Team Meetings and Events

Product Lifecycle Focus Area

7-8 Oct 03: Product Development Meeting, Cambridge, MA

30+ members of the LAI product development (PD) community met on 7-8 October in Cambridge MA to hear about the latest in research and practice in lean PD. The group also heard about the latest in tools to improve PD, and had a chance to experience the LAI PD training simulation. There was very active discussion and the meeting successfully continued the tradition of the LAI creating a forum for learning and sharing among consortium members.

Research presentations included work on a rapid architecture trade-off selection method by Hugh McManus, Metis Design; Spiral development by Eric Rebentisch, MIT; Vicarious learning in teams by Henrik Bresman, MIT; PDM implementation by Erisa Hines, MIT; Enterprise product strategy by Ted Piepenbrock, MIT; Reusable specification components for model-based system engineering by Nancy Leveson, MIT; and a discussion of future LAI PD research priorities by Warren Seering, MIT.

Several speakers from industry shared the experience of their own lean journeys, with discussions on Lean for Engineering by Peggy Holly, Boeing Integrated Defense Systems; Engineering Employee Engagement by Keith Smith, Boeing Commercial Aircraft; Lean in software and information systems by Aprille Lucero, Lockheed Martin Space Systems; How to use tools to enable lean product development by Kevin Otto, Product Genesis; and Lean enterprise approach to programs by Mark Bowie, Boeing Integrated Defense Systems.

Discussions on new or emerging tools of interest to the community included an update on the status of the LAI PDVSM, including recent experience applying it to a major system by Hugh McManus, Metis Design; and update on related LAI tools in development by Alexis Stanke, MIT; Product Development Capability Assessment Survey by Vic Tang, MIT; QFD Progression Approach by Stan Weiss, Stanford; The Learning to Develop Toolset by Ed Peterson, Aerojet; and Emerging initiatives in lean systems engineering by Donna Rhodes, MIT.

The community provided many suggestions to help prioritize future research and tools development within LAI. Presentations from the session will appear on the LAI website in the next few days.

17 Dec 03: Research Workshop on PDM/PLM Industry Use and Strategy, Cambridge, MA

On December 17, 2003, five members of the consortium representing Boeing, L3 Communications, and Textron Systems, attended a one-day workshop in Cambridge. The purpose of the workshop was to support and help shape product lifecycle research being conducted by a current LAI student, Erisa Hines. The research focus is on PDM/PLM (Product Data Management/Product Lifecycle Management) use in the aerospace industry, and what that means to product lifecycle capabilities and enterprise integration. From the workshop, key areas of interest were identified and developed in a way that could be addressed by this first look at the subject. A research plan was then agreed upon that would be successful in fulfilling the industry need. It was decided in the workshop that an industry survey would be useful to 1) Assess the current state of use and capability in the industry and 2) Answer common questions among strategic developers within the consortium. From there, case study locations will be determined for the second part of the data collection. A look at examples in other industries is also expected as well as inclusion of the vendors involved with PDM/PLM application development.

The group in attendance will continue to be involved in the survey development prior to deployment and was enthusiastic about the plan set forth. We discussed the potential of holding future meetings regarding this topic for a larger proportion of the industry. This will be pursued if desired by the community.

19 Jan 04: Value Of Enterprise Process Management Meeting

The LAI research group at MIT is researching various topics related to Lean Enterprises, and one of these topics is the value of managing processes at the enterprise level. A meeting was held on January 19th with selected participants who have innovative initiatives ongoing on enterprise process. The purpose of the meeting was to share industry experiences and lessons learned, and discuss areas where future research could be helpful. Participants included Boeing, General Dynamics, Lockheed Martin, LAI@MIT, Northrop-Grumman, Raytheon, and Software Productivity Consortium. Participants found value in hearing about the approach and experiences of their industry colleagues in enterprise process transformation, and expressed interest in having a follow-on event sometime in the coming year, perhaps widening the participation to commercial companies as well as broader LAI member participation. For further information, contact Donna Rhodes, rhodes@mit.edu.

24 Feb 04: Revitalizing Systems Engineering Action Team Meeting, Arlington, VA

The LAI Action Team for Revitalizing Systems Engineering met on February 24th at SAF/ACE in Arlington VA. This team has been meeting to address a request from Dr. Marvin Sambur, Assistant Secretary of the Air Force for Acquisition. Dr. Sambur asked the LAI Executive Board to consider how LAI can contribute to the Air Force's initiative to revitalize Systems Engineering. A first exploratory/planning meeting was held on January 13, 2004 and a second meeting on February 5th. In this recent meeting, the team finalized a proposed action plan that will be presented to Dr. Sambur for his consideration. A special breakout session at the LAI Plenary Conference will highlight the SE Revitalization initiative and discuss LAI's plans to assist.

25 Mar 04: Product Development Meeting, Dana Point, CA

The LAI Product Lifecycle knowledge area met on 25 March 2004 at Dana Point CA for a meeting to discuss product development (PD) and systems engineering (SE) topics. The meeting was well-attended with representation from industry, government, and academia. Donna Rhodes from MIT and Mark Wilson from the Air Force Institute of Technology (AFIT) Center for Systems Engineering reviewed current efforts focusing on defining and implementing leading indicators for systems engineering and program performance improvement. Charles Sheffer from Boeing Commercial Airplanes group discussed leading metrics in use at Boeing Commercial Aircraft for managing product development. The community split into 2 discussion groups to discuss metrics and incentives for PD and Lean systems engineering to capture the experience and knowledge of the community. In both cases, the knowledge captured will be used as input to on-going activities relating to SE revitalization activities within both the USAF and DoD.

Bo Oppenheim from Loyola Marymount presented a Lean PD flow framework that provides guidance and a structure for applying lean principles to a product development process. Vic Tang from MIT provided a status update of a PD assessment survey under development, and discussed his research on techniques to enhance the robustness of decision processes in PD. The community divided into 2 discussion groups to discuss lean decision processes in PD and to create a framework for an enterprise lean PD toolset. The outcome of both discussions will feed into on-going research and tool development efforts in the LAI product lifecycle knowledge area.

8-9 Jun 04: AF/LAI Workshop on Systems Engineering for Robustness

More than 70 leading systems engineers attended the June 8-9 invited workshop held at the SAF Conference Center in Arlington, VA. Sponsored by Dr. Marvin Sambur, Assistant Secretary of the Air Force for Acquisition, and organized by LAI, the purpose of the event was to accelerate the implementation of recent Air Force and Department of Defense (DoD) policy and initiatives for systems engineering revitalization.

26-27 Aug 04: AF/LAI Initiative on Leading Indicators for Systems Engineering

As a follow-on activity to the recent AF/LAI Workshop on Systems Engineering for Robustness, a working session was held August 26-27 in Bethesda, MD. The session included Air Force and LAI representatives, along with invited experts on systems engineering indicators and measurement practices. This initiative was focused on recommending several new leading indicators for good systems engineering to supplement the set of leading indicators published in the AF Guide for Engineering Robust Systems. For further information, contact Donna Rhodes at rhodes@mit.edu.

Enterprise Change Focus Area

5 Dec 03: Sustaining Lean Change Working Group Meeting

On 5 December, 2003 at MIT in Cambridge MA, a diverse group of twenty-one people – from industry, government, MIT faculty, staff and students – met to discuss and further the agenda of a working group for “improving effectiveness of organizations and all the

employees across the total enterprise” (LAI Goal 5). We agreed to call ourselves the “sustaining lean change” working group. A draft charter for the group was reviewed and will be revised based on the discussions and feedback. In addition to hearing and discussing MIT research efforts, both the Enterprise Change research plans of LAI, and Prof. Carroll’s research on leadership for transformation in the Millstone Nuclear Power plants, we each brought key questions critical to our own efforts in furthering lean enterprise transformation. These questions, along with presentations and discussions of labor and management challenges in integrating work forces development with lean, resulted in discussions of four challenges for social and organizational issues related to lean transformation:

1. collective bargaining, contracting and human relations
2. structure and mechanisms within and across organizations
3. measuring and sharing success and progress
4. cross-organizational and enterprise strategy and issues

Next Steps:

The discussions from this meeting will help focus the research efforts that are ongoing in LAI and LARA. We agreed to a series of future meetings, including one day either before or after the LAI plenary. All of these meetings would focus on particular aspects of Goal 5 as defined by the above four challenges. Other future meetings will be hosted at member sites, with defined outcomes and take-backs for participants, and include an inquiry into an aspect of the host’s lean enterprise transformation. Col. Bailey offered Warner Robins ALC as a site for a future meeting. Details of meetings and notes from this meeting will be available in several weeks.

25 Mar 04: Sustaining Lean Change Working Group Meeting, Dana Point, CA

This meeting was well attended on 25 March 2004 at Dana Point CA with over 30 participants. Session Chairs Chris Cool (NGC) and George Roth (MIT-LAI) set the stage with a group introduction and a brief discussion regarding change management and lean success. The majority of the day focused on presentations regarding enterprise change in industry and government, as well as industry/government and union relations under the broad umbrella of lean. Mr. Campion (NGC) began with a presentation of successes and missed opportunities within the lean enterprise change initiative in the Northrop Grumman Human Resources and Administration area. All participants appreciated his candor regarding lessons learned, and the intermittent questions and discussions covered a wide variety of topics. Jerrell Smith (Boeing) expanded upon his presentation from the Lean Success Breakout Session and further elaborated on the unique Boeing Production System. Again, discussion among the group was quite candid and informative. Following these industry focused presentations, our attention was turned to lean enterprise transformation at the Warner Robins Air Logistics Center, and the complimentary MIT-LAI case studies being conducted. Gregg Beecher (WR-ALC) introduced everyone to the history of lean efforts as the ALC, with a particular emphasis placed on the Maintenance programs. Anthony Dunn (WR-ALC) and John Dickmann (MIT-LAI) added important details during their presentations of lean successes and challenges with the C-5 and C-130 Program Depot Maintenance areas. While Anthony chose to focus on the marked production improvement made possible by lean, John focused on the new challenges faced due to increased customer demand. Jessica Cohen

(MIT-LAI) finished the morning with a discussion of lean as applied to the purchase requesting process at the ALC. The afternoon began with Lydia Fraile (MIT-LARA) bridging the gap between government lean activities and the importance of union personnel. Tom Pinski (Boeing-IAMAW) continued with further information regarding the great significance of "what a union can do for you" when it comes to lean improvements. This presentation truly engaged all workshop participants and allowed each person an opportunity to share their union/management experiences. The focus of the working group then returned to overall enterprise transformation as George Roth (MIT-LAI) recapped the efforts at Warner Robins ALC, while linking all of the presentations together. In the final, formal presentation of the day, Henrik Bresman (MIT-LAI-Sloan) presented his research concerning vicarious learning and its implications for lean transformation. Following Henrik, George Roth (MIT-LAI) presenting the results from the preceding day's Enterprise Change Survey. The results were both expected and surprising in different regards. The day concluded with an open discussion about the next direction for the Sustaining Lean Change Working Group. A tentative meeting was scheduled for September 2004 at the Northrop Grumman St. Augustine, Florida location. That meeting will likely focus on the use of metrics in the sustainment of lean change.

Enterprise Architecture Focus Area

5 Jan 05: LAI Metrics Team Workshop with Textron

On 5 January, the LAI Metrics Research Team met with David Roy, vice president of Six Sigma at Textron Systems, to review progress to date, chart data collection tasks for the immediate future, and hear of Textron Systems' several metrics efforts. Team members present were George Roth, Vikram Mahidhar and Jayakanth Srinivasan of MIT/LAI, and Geoff Bentley of Textron.

The goal of the effort was to focus on a single metric that can be collected from LAI member companies, used to evaluate progress of lean activities, and that reflects the overall health of the enterprise. Return on invested capital is being tested as such a top-level, outcome metric. Next steps include understanding the metrics programs of other LAI consortium members.

Knowledge Deployment Focus Area

8 Dec 04: Communications Committee Team Meeting, Cambridge, MA

11 Jan 05: Communications Group Meeting, Arlington VA

This was the first meeting of this group with communication professionals as part of the team. Pratt & Whitney, the U.S. Air Force, the Boeing Company, Textron Systems and Raytheon all provided communication professionals for this group. Bill McDaniel, the LAI communications director, led the meeting, whose purpose was to start the development of a LAI Communications Plan. To kick off the meeting, an LAI overview was provided for the communication specialists to give them a foundation on all aspects of LAI including current

communication materials. With this background, the team participated in a very energetic process to develop the first item of the communication plan - the LAI message. A communication plan outline was briefly discussed and future meetings were planned. 08 Feb 05: Communications Group Meeting, Cambridge, MA

15 Feb 05: LAI Communications Group Meeting, Cambridge, MA

9 Mar 05: LAI Communications Group Teleconference

12 Apr 05: LAI Communications Group Teleconference

25 May 05: LAI Communications Group Meeting: Washington, DC

Hosted by the SAF/AQ, this meeting concentrated on constructing an LAI overview presentation, largely based on the LAI Overview now on the LAI Web site. Aided by Jan Martinson, the group took apart the most recent version and reassembled it into a workable, robust presentation. More work needs to be done on some new material, but the end is in sight. Using this core group of slides, any member can modify the presentation to fit specific needs. In addition, the group discussed new ways to promote LAI activities, specifically the upcoming Short Course in September and the 2006 Plenary Conference. Based on the group's recommendation, the Short Course synopsis will be offered to member companies for inclusion in the curricula of their corporate universities or training courses. The group also suggested using alumnae testimonials, among other ideas. Finally, the group suggested a number of ways to actively promote the 2006 Plenary Conference, including changing the name from Plenary; using paper announcements and invitations; and developing a synopsis of the Conference for use on the Web site and by Champions and others to promote attendance.

17 Jun 05: LAI Communications Group Teleconference

5. *Lean Now Activities*

3-7 Feb 03: Global Hawk, Enterprise VSM, Dayton, OH

The Lean Now Global Hawk Enterprise Value Stream event was conducted at the Northrop-Grumman facility in Dayton, OH during the week of 3 February, 2003. The purpose of the event was to:

- *Map Key Process Interfaces Within Program
- *Identify Agreed Upon Improvement Areas
- *Establish Targets and Metrics for Cost / Cycle Time Reductions, and
- *Determine Schedules / Milestones for Follow-on Events

The event was attended by members of the Global Hawk SPO and industry members of the Global Hawk team. LAI industry member facilitators from Northrop-Grumman, Raytheon, and Boeing were on hand to facilitate the successful event. The event was briefed to MG

Mushala, AFMC/DR on 7 February, 2003. The Enterprise value stream map was generated and through that process, five areas of opportunity were developed:

- * Air Force Requirements Development and Program Planning
- * Alpha Contracting
- * EMD Development and Test
- * Production / Supply Chain
- * Change Process

Each opportunity area will be addressed via either a Kaizen event or a VSM of it's own to identify areas for improvement and determine the actions necessary to close on those opportunities. The next Global Hawk event, an Alpha Contracting Value Stream Map, will be conducted during the week of 17 February.

3-7 Feb 03: F/A-22 Enterprise VSM, Dayton, OH,

The Lean Now F/A-22 Enterprise Value Stream event was conducted at the Lockheed Martin facility in Dayton, Ohio during the week of 3 February, 2003. The purpose of the event was to:

- Develop a detailed lean improvement plan
- Clear, achievable targets in cost and span reductions
- Data driven decisions on improvement areas, and
- Milestone-driven schedule of lean events to achieve targets

The event was supported by team members; F/A-22 SPO, Lockheed Martin Aero, Boeing, Pratt and Whitney, LAI, and LAI. The event co-leads were Greg Staley (F/A-22 SPO) and Don Handell (LM Aero). The successful VSM event was briefed to MG Mushala, AFMC/DR on 7 February, 2003. A total of 20 lean projects were identified and have been scheduled as either a Kaizen or VSM as appropriate. The top 20 projects designed to improve project execution will be conducted throughout 2003, with the first beginning the first quarter of this year.

5 Feb 03: F-16 CONTRACT CLOSEOUT

LAI Lean Now Status briefing to MG Mushala - A status briefing was conducted for the F-16 Prototype project on 5 February, 2003 at AFMC/DR. The event summary was briefed and a schedule of follow-on events was presented. The next major event will be a Contract Closeout event conducted at the Lockheed Martin Aero Facilities, Fort Worth, TX the week of 17 March. These events are a natural progression of data collection and analysis coupled with detailed Value Stream Mapping to determine the actions necessary to eliminate barriers to the contract closeout process.

A LAI Lean Now workshop was conducted for the F-16 SPO on 13 February, 2003. The event attended by over 35 members of the F-16 SPO team was very well received and generated a great deal of very good dialog. Workshop participants were energized and enjoyed the participatory nature of the workshop. Comments received after the workshop were very positive and demonstrated the value of the Lean Experience "The use of case studies helped drive home the point of actually learning how to use your resources effectively and focusing on customer needs".

18-20 Feb 03: Global Hawk Alpha Contracting

The Global Hawk Alpha Contracting Value Stream Map event was conducted at the Northrop Grumman facilities in Rancho Bernardo, CA 18-20 February, 2003. There were 35 participants and facilitators representing, The Global Hawk SPO, Program office, DCMA, and major suppliers. The objective of the event was to begin the process to reduce the fly away cost and reduce cycle time for delivery to the war fighter as a collaborative lean initiative. Detailed VSMs were generated for Phase I (requirements definition) and material and labor. Upon completion of the "as-is" states over 200 process improvements were cataloged. These process improvements were reviewed and a list of top improvements was generated which will be converted into events, "just go do its" and Kaizens, depending upon their complexity. The event resulted in an initial 28% reduction in the Alpha contracting process.

17-21 Mar 03: F-16 Closeout Contract VSM Event

The F-16 Lean Now Contract Closeout Prototype team conducted two weeks of intensive efforts between 10 and 21 March. During these events all stakeholders were represented by participants from the F-16 SPO, Lockheed Martin Aero, DCMA, DCAA, and DFAS. The events were conducted at the Lockheed Martin Aero Fort, Worth Facility. The first phase performed by the core team, 10-13 March, 2003 provided the baseline analysis for the senior level team to work during the week of 17th March. The core team identified barriers to closing out F-16 Inactive (Old-Dog) Contracts. They generated a list of those barriers, categorized those barriers, performed cause and effect analysis on each barrier, and generated potential solutions for eliminating or reducing the barriers. An initial business case analysis on selected barriers was performed prioritizing barriers

The senior management team then met during the week of 17 March. This was the second of the two phases and was performed by a Senior Enterprise team including both deputy program managers from the Government and Lockheed Martin Aero teams. During the week they evaluated the barriers and solutions outside the control of the core team and identified next steps and implementation plans. The objectives of the second week of effort were to define an implementation plan to eliminate those barriers that are within the team's control, identify and elevate barriers and recommended solutions, and integrate the effort into ongoing DFAS/DCMA/DCAA initiatives.

At the end of the Senior enterprise team event it was concluded that the "Spiral II stakeholders" inclusion (DCMA including DCMA Headquarters representatives, DCAA, and DFAS) was tremendously beneficial to the successful completion of the week's efforts. Results during the second week included:

- Substantive barriers identified, root cause analysis performed, and solutions generated
- Down-selected from 18 proposed solutions, eliminated three, 'parked' three, and developed 12 preliminary implementation plans to include a methodology for tracking the implementation plans
- Solutions isolated into two categories into two categories: (1) Eight within the control of this team; and (2) Four to be elevated
- Projected a minimum cost avoidance of \$2.4M

- Project cycle time reduction of 3-7 years
- Elevated proposal to Defense Acquisition Regulation Ad Hoc Committee on Contract Closeout for implementation of business analysis cost effectivity approach to contract closeout of small-value cost-type and T&M contracts

The end results of the two week effort provided an initial road-map to reduce the effort necessary for closing out inactive contracts. Congratulations to the F-16 Lean Now Contract Close out Team!

5-8 May 03: Lean Now Green Belt Training Module & Strategy Meeting

The 5-8 May event at Boeing, St. Louis, was very successful. We completed developing a draft 40 hour green belt training module and also developed the first look at a strategic planning concept for culture change within AFMC. Team members included: Tracy Houpt, Lockheed Martin; Wes Switzer, Boeing; Bob Blair, Raytheon; Melissa Meyer, Northrop-Grumman; LTC Scott Miller, DAU; Maj. Ron Jobo, MIT/LAI; Alexis Stanke, MIT.

Each team member brought copies of their training material for inclusion in the "LAI" version of the green belt training. By the end of the week we had completed a straw man five day green belt syllabus. Tasks remaining are cleanup of individual modules, integration of all modules (similarity of content), and final team review of the completed course. The course will be ready in time to support the Wave 2 projects. It was an outstanding effort on everyone's part. The team came together very quickly and generated the over all outline by day and then the actual module content. What we accomplished in a few short days is nothing short of extraordinary when one considers the time, resources and dollars it would take the Air Force to generate such a course. This is another example of the LAI consortium at it's best.

10-11 Jun 03: Lean Now Wave 2 SME Conference

This successful conference, hosted by Lockheed Martin Aero in Marietta GA, was an excellent opportunity for all participants to become orientated to the LAI Lean Now process and begin initial contact with the Wave 2 government teams. On 10 June we conducted a series of briefings which included:

- LAI Vision, Strategic Imperatives and Goals
- LAI and Lean Now Overviews and video
- LAI Lean Now Workshop Review
- LAI Wave 1 Engagement Process
- Wave 1 Lean Now Project Reviews and lessons learned and introduction of the Wave 2 Projects

On 11 June we completed a series of five one-hour conference calls with the government team leads to initiate each of the five projects.

1. Turbine Engine Development - Doug Hottman, Rolls Royce and Ida Gall, Pratt and Whitney
2. Joint Stars Flight Manuals - Melissa Meyer, Northrop Grumman and Amy Newman, Rockwell Collins

3. Air Logistics Center Lean Institute - Alexis Stanke, MIT/LAI and Bob Blair, Raytheon
4. Traveling Wave Tube Strategic Sourcing - Geoffrey Bentley, Textron Systems, Nick Montalbini, Textron Systems and Bob Blair, Raytheon
5. DAU Course Development - Bob Blair, Raytheon and Alexis Stanke, MIT/LAI

With the successful initial contact conference calls all five of the Wave 2 projects are now off and running.

25-29 Aug 03: Lean Now, Turbine Engine Test & Evaluation For Development, Qualification & Sustainment

The Arnold Engineering and Development Center, Lean Now prototype, Turbine Engine Test and Evaluation for Development, Qualification and Sustainment Enterprise Value Stream Mapping event was conducted the week of 25 August, 2003. This was the first time that the entire engine test enterprise was gathered together to map their critical process. The event was an excellent example of what can be accomplished with detailed up front team planning and flawless execution. The "Turbine Engine Enterprise", consisting of all three major engine manufacturers (General Electric, Pratt & Whitney, and Rolls-Royce), AEDC, Air Force, Navy and the Army came together to eliminate waste and generate value for all the stakeholders. Facilitization was provided by LAI SMEs from Boeing, Pratt & Whitney, and Rolls-Royce. The event highlighted many possible areas for improvement which were classified into three areas, A, B and C, with As being the most significant. There were a total of 11 projects which fell into the A and B categories. These projects are in the process of being prioritized so that the necessary resources may be deployed to affect the changes highlighted during the event.

8-12 Sep 03: LAI Facilitator Training, Ogden AFB, Ogden, UT

On 8-12 September 03 an LAI team trained 23 lean facilitators from Ogden Air Logistics Center at Hill AFB, Utah. Facilitators, who were hand picked from multiple OO-ALC organizations (MA, LG, LH, XP), are expected to apprentice with lean mentors and be certified to support lean projects and events at OO-ALC. Col Maquet, who leads the Ogden Transformation Office, attended the class and was delighted with the quality of the content and results.

The facilitator training developed by a team comprised of the Air Force, Boeing, Lockheed Martin, MIT, Northrop Grumman, Raytheon and Textron was piloted for the first time. The training pulled the best from each company and was designed to build knowledge and skills lean facilitators will need to support project work. The training was conducted by the following LAI representatives: Wes Switzer (Boeing), Terry Bryan and Alexis Stanke (LAI at MIT), Tracy Houghton (Lockheed Martin), Bob Blair (Raytheon), and Geoff Bentley and Nick Montalbini (Textron). Participants proclaimed that they now had the tools they needed and just needed to do it.

17-19 Sep 03: LAI Lean Now Workshop, Hill AFB, Ogden, UT

On 17-19 September 03 an LAI team presented the LAI Lean Now workshop to an Ogden Air Logistics Center project team at Hill AFB, Utah. In addition to the workshop the team

also completed planning for a Value Stream Mapping (VSM) activity scheduled for the week of 6 October. Data will be gathered at the site to support the VSM activity during the week of 6 October.

The workshop presented an overview of lean concepts and tools using an interactive style to engage the participants in multiple exercises. Content includes an Ice breaker, NASCAR video, Fundamentals of Lean, Lean concepts and tools, a Harvard Business school case study which highlights Lean in an "off the production floor" environment, team discussions, lean enterprise, the "Big Picture" and leading transformation. The workshop, developed by a team comprised of MIT and four LAI industry member companies (Boeing, Lockheed-Martin, Northrop-Grumman, and Raytheon), pulled the best from each team to familiarize the participants with lean concepts. The workshop was attended by forty OO-ALC participants. Wes Switzer (Boeing), Bob Blair (Raytheon), Geoff Bentley and Nick Montalbino (both Textron) conducted the workshop. Bob Blair, Geoff Bentley and Nick Montalbino facilitated the VSM activity planning session.

The planning activity formed cross functional teams to gather data which will be used to analyze current state and prioritize project opportunities. The planning was completed and all participants demonstrated their support by signing the Vision and Scope for the project. Data gathering teams are each sponsored by a team leader and are staffed with cross functional resources and a facilitator from OO-ALC.

6-9 Oct 03: Lean Now SME Event, Hill Logistic Center,

A team of LAI subject matter experts led a team of 20+ Hill Logistic Center employees (OO-ALC) through an assessment of their Purchase Request process. The assessment delivered the following: an understanding of current state process; identification of undesirable effects, constraints, long poles in the contracting process; prioritized listing of solutions/project opportunities; a future state process map; and planning for next steps. Participants from Boeing, Raytheon and Textron supported the event.

19-20 Nov 03: F-16 SPO Lean Workshop, Dayton, OH

A Lean Now workshop was presented to the F-16 SPO on 19 and 20 November, 2003 in Dayton OH in support of their goal to train all SPO team members in Lean. Two one day sessions were conducted. The lean now Workshop provides an overview of lean from its beginnings to deployment of enterprise lean concepts. The workshop is presented in an interactive format that involves all participants. The presentations are augmented by a simulation, based on a Harvard Business School Case Study, which demonstrates the use of lean tools in an "off the floor" non-production environment. Lean Now SMEs representing Boeing, DAU, MIT, and Raytheon facilitated the workshop.

2 Dec 03: Electronic Systems Command Prototype Project Events, Hanscom AFB, MA

A One-Day Lean Now Workshop was conducted for approximately 20 members of the Electronic Systems Command at Hanscom AFB on Tuesday 2 December, 2003. Lean Now SMEs representing Boeing, ESC and Raytheon facilitated the workshop. There was a lot of interaction and many good questions from the audience which included members of the ITSP Process Improvement Team.

The following day, Wednesday, the ITSP Process Improvement Team, lead by Chris Smallis and facilitated by an SME representing Boeing and LtCol Rob Dare, ESC, completed a process map for the ITSP process. Both pre-award and post-award activities were included. After defining the flow for all of the process steps, the team then identified and labeled each step as value-added, non-value-added, and non-value-added-but-necessary, (green, red, and yellow). The team then defined the data collection requirements and next actions in preparation for the upcoming Value Stream Mapping event. Here they will convert the Process Map to a Current-State Value Stream Map, brainstorm improvement ideas, down-select and prioritize improvement activities to create a Future-State VSM, and create an action plan.

10 Dec 03: Subject Matter Expert (SME) Recognitions

The following Lean/Six Sigma experts were honored recently in Washington, DC for their outstanding efforts as a lean subject matter expert (SME) and their contributions in support of the Lean Aerospace Initiative (LAI) and its Lean Now program.

- Wesley Switzer from the Boeing Company
- Tracy J. Houpt from Lockheed Martin
- Alexis Stanke from MIT
- Robert Goetz from Northrop Grumman
- Melissa L. Meyer from Northrop Grumman (not present but honored)
- Ida Gall from Pratt and Whitney
- Thomas O Winfield from Raytheon (not present but honored)
- Renee A. Linehan from Raytheon
- Bob Blair from Raytheon
- Amy L. Newman from Rockwell Collins
- Douglas A. Hottman from Rolls Royce
- Geoffrey K. Bentley from Textron Systems
- Nicholas Montalbino from Textron Systems
- Lt Col Scott V. Miller USAF, from DAAU (not present but honored)

SMEs actively assist teams in working together to improve processes at the government/industry interface. They work as an LAI advocate and objective facilitator with the various project teams and share their knowledge and years of experience in the neutral forum provided by LAI to learn from other SMEs, in turn bringing the "best of the best" training material and implementation practices to projects at the interface between industry and government.

The SMEs have been instrumental in creating a structured, fact-based, action-oriented approach that has achieved measurable results for the Air Force and its industry partners. The customer focus of LAI member organizations has enabled this effort to flourish. Thanks to a substantial investment of time and energy, these SMEs have made the Lean Now initiative a success.

21-23 Jan 04: Lean Now Event: ESC, ITSP Process, Hanscom AFB, MA

A Lean Now event (Electronic Systems Command, ITSP Process) was conducted at Hanscom, Electronics System Command the week of 21-23 January, 2004. Supporting LAI industry member Subject Matter Experts (SME) from Boeing and Rockwell Collins facilitated the event. This event, was a culmination of a series of events which began with initial engagements, beginning 13 November, 2003, during which events and training was conducted which described an Overview of Lean Now, the Value Stream Mapping Process and presented Project Scope, Objectives, Expectations, and identified Key Stakeholders. The engagements continued with a Lean Now Workshop, (Team members and open enrollment), initiation of a VSM, (Inputs, Outputs, Process Flow) on butcher paper and defined data to be collected prior to the VSM event. These preparatory events resulted in:

- Completion of the VSM on 21-23 January, 2004,
- A review of process flow, and added data,
- Brainstorming and prioritization of improvement ideas, (PICK Chart),
- Completed 9-Block Charts for "Go-Forward" ideas, and
- Identified Stakeholders and brainstormed characteristics of an "Ideal State"

Additional events are planned for this project.

28-29 Jan 04: Lean Now SME Conference, El Segundo, CA

The first 2004 Lean Now, Subject Matter Expert (SME) conference was held 28-29 January in El Segundo, CA, hosted by Northrop Grumman, Integrated Systems. The conference was attended by approximately 30 people representing all the Lean Now projects, and government and industry member guests. A Northrop Grumman company overview and Lean Program overview was presented in the morning. Project reviews were conducted throughout the day and concluded with a discussion of ideas for taking Lean Now to the next level. On 29 January, a tour of the Northrop Grumman F-18 production line and advanced Composites Center was conducted and highlighted the implementation of lean methodologies throughout the facility. The next SME conference will be held the Monday just prior to the March Plenary Conference. For that conference we will be opening up conference attendance to all practitioners and requesting papers detailing industry success with large-scale industry lean transformation.

22 Mar 04: Lean Now SME and Change Agent Meeting, Dana Point, CA

An LAI Lean Now conference was held on 22 March 2004 at Dana Point CA as a precursor to the LAI Plenary conference. For the last year and a half the LAI consortium has been engaged in the highly successful Air Force Lean Now Initiative. Throughout that period there have been many engagements to aid in the transformation of the Air Force Materiel Command. These engagements have resulted in the development of many procedures and methodologies that have been used to deploy lean in the selected project and process areas. The purpose of this meeting was to develop a overarching process for large-scale transformation using the lessons learned on the Lean Now Initiative and member experiences. The 28 LAI Lean Now Subject Matter Experts and industry change agents gathered to develop an overarching process for the engagement of large-scale enterprises. At the conclusion of the day's activities, draft processes had been developed for areas such as entry criteria, process selection, host program selection, team training, steering committee

development ,event conduct, metrics, exit criteria, and infrastructure to name a few. The change agents broke up into 10 teams and brainstormed the process throughout the day. The work completed during this event will form the beginning of a detailed process expansion of the LAI Transition to Lean Roadmap (TTL). Our thanks for all the work that was accomplished by the teams throughout the day. An outstanding beginning for the next level of transformation processes.

Apr 04: NAVAIR Test & Evaluation Briefing

The Lean Now Combined Test Force (CTF) project (F/A-22 Host Program) has resulted in multiple successful lean projects conducted at the CTF throughout the last year which have improved processes for test. Lean aided in creating a higher degree of teamwork and to open communication channels. CTF lean events have been educational to all members. Savings in time, effort and efficiencies have been found and implemented. In order to deploy the successes and lessons learned from the F/A-22 CTF Combined Test Force, a team from the F/A-22 CTF and LAI presented their experiences and successes to Naval Weapons Station, China Lake, California leadership and key members of the NAVAIR Test & Evaluation community on 1 April, 2004. The purpose of the briefing was to transfer Lean Now lessons learned from the F/A-22 CTF to other government members of LAI.

26-30 Apr 04: Arnold Engineering Development Center Facilitator Training, Manchester, TN

This years first offering of the Lean Now 40 hour facilitator course was presented 26-30 April at the Gossick Leadership Center, Arnold Engineering Development Center (AEDC), Manchester, TN. Twenty-nine candidate facilitators representing AEDC, the Aerospace Testing Alliance, Eglin Air Force Base, and the Engine SPO at Dayton Ohio attended the training. The intensive one week course is designed to prepare facilitators to execute projects generated through the Lean Now process. Members of this most recent class will be facilitating a broad range of nine major projects identified during multiple AEDC conducted Lean Now Value Stream Mapping events throughout the greater AEDC enterprise. The nine projects will support the AEDC Lean Now project, Turbine Engine Test from Concept to Sustainment. Candidate facilitators have been assigned their projects and will work in teams of 2 or 3 facilitators, mentored by LAI black belts. The course was very well received by all who attended; "The Facilitator training course was an absolute 100% smash hit!" The course was presented by LAI members representing, the Air Force Ogden Air Logistics Center, Aerospace Testing Alliance, Pratt and Whitney, Raytheon, Rockwell Collins and Rolls Royce.

24 Jun 04: Ogden Air Logistics Center Wave 2 Lean Now Project

A wrap-up of the Purchase Request Central Pilot Program and celebration of the achieve phase was held on 24 June. In a two-day workshop, results were presented showing that savings of \$1 million per year can be realized as flow time is reduced from 29 to 12 days during the coordination phase of the procurement cycle.

The Pilot Program consisted of a sample of 152 procurement requests from the Landing Gear and Power Systems product lines during the test period of 5 April - 8 June. The efficiencies gained from implementing the Pilot's processes are being extended to other product lines

within the Ogden ALC. The approach used for Ogden's Pilot will be the basis of improved, centralized procurement among the other logistics centers. LAI members representing Textron Systems and Raytheon were the Subject Matter Experts facilitating the effort.

12 Jul 04: Arnold Engineering Development Center Take-Aways

A community of practice meeting was conducted to review project status on nine major projects identified as a result of the EVSMA conducted on the Wave 2 Lean Now project, Turbine Engine Test from Concept to Sustainment. Each project presented its status and plan for project completion. All projects, facilitated by AEDC facilitators trained via the LAI 40-hour facilitator course, are making excellent progress. Each project facilitator team described the team's progress and status, with many of the projects through or nearing completion of the as-is value stream map. A major review is slated for presentation to the Engine SPO in August. Facilitator teams are mentored by LAI SMEs representing the Aerospace Test Alliance, Pratt & Whitney, Rockwell Collins and Rolls Royce.

2-3 Feb 05: LAI Lean Now Team Engages EC-130 Compass Call Program, Waco, TX

A highly successful series of events recently were completed on the EC-130 Compass Call Program at the L-3 Communications Integrated Systems (L-3 Com)/Air Force Detachment 4 facility in Waco, TX. On 2-3 February, 2005, a site visit was conducted at the Compass Call facility as a precursor to an intense engagement period. The Lean Now Workshop was conducted on 15 February, with participation from L-3 Com vice president-level to the core Value Stream Mapping Team. A total of 34 participants attended the workshop, with excellent engagement by all participants.

The second block of events, conducted 23-25 February, 2005, consisted of the MIT-developed Lean Enterprise Value Simulation and the generation of the beginning of the enterprise Compass Call VSM. The LEV simulation was tailored specifically for this event to replicate a depot repair/modification process and represents the first time it has been used in this specific form.

By the time the LAI team returned on 7 March to begin the week-long VSM event, the Compass Call teams had completed a series of seven outstanding, very detailed lower-level VSMs. These encompassed all major value streams within the Compass Call program and provided excellent data with which to develop the Compass Call Enterprise "As Is" and "Future" value stream maps.

6. Educational Network (EdNet)

9-10 Jun 03: LAI Educational Network Summer 2003 Meeting

A group of educators and industry representatives came together to discuss the results of a Lean Summer Academy pilot as well as a progress report from a Lean Systems Engineering working group. The meeting was graciously hosted by the Loyola Marymount University in Los Angeles, CA. Highlights of the meeting included a dinner with a speech by Jan

Martinson, VP for Lean Enterprise, Boeing IDS, and a tour of Boeing C-17 to get a first hand look at lean implementation.

Lean Systems Engineering Working Group:

A special interest group has formed from the EdNet to discuss the intellectual convergence of lean principles and systems engineering and how lean can be integrated into graduate level systems engineering courses. The working group has met several times via telecons or in-person meetings and will continue to do so in the future.

2-6 Jun 03: Lean Summer Academy Pilot

The inaugural Lean Academy class completed a pilot offering of the Lean Summer Academy June 6, 2003. The one-week offering is targeted at undergraduate students in conjunction with an industry experience, such as an internship or co-op assignment. The Lean Summer Academy pilot was offered June 2-6, 2003 at Rolls-Royce Corporation in Indianapolis, IN for 25 summer interns. The faculty for the week included participation from the Department of Aeronautics and Astronautics at MIT and the Krannert School of Management at Purdue. It was a successful week, with feedback from one student, "Incredible, I learned so much in the week!"

16-17 Oct 03: LAI EdNet Fall 2003 Meeting: Belvoir, VA and Baltimore, MD

A group of 32 educators, industry, and government representatives came together for the most recent EdNet meeting. Defense Acquisition University in Ft. Belvoir, VA and Northrop Grumman Electronic Systems in Baltimore, MD graciously hosted the meeting. Program highlights included a dinner with speaker Col William Guinn, Commander of Letterkenny Army Dept, lunch with speaker Chris Cool, Northrop Grumman Integrated Systems VP for Enterprise Integration, and a tour of the Northrop Grumman Electronic Systems Baltimore facility to get a first hand look at lean implementation.

This meeting was well attended, with a core group of ten schools that have been participating in the EdNet for the past year as well as new faces from five schools. In addition to presentations by DAU and Northrop Grumman, the group explored several opportunities to enable the EdNet mission. These included new electronic infrastructure to support instructor-to-instructor (i2i) exchange of curricula materials, as well as funding opportunities through NSF. Break-out sessions also convened on the topics of integrating lean into undergraduate, graduate, and professional development programs. Specific focus was given to continued development of the Lean Academy and lean systems engineering concepts. These subgroups made plans for follow-up actions and meetings to drive ideas into action.

12-16 Jan 04: LAI Lean Academy™ for Instructors

The LAI Lean Academy™ for Instructors class, held 12-16 January 04, completed with a cadre of new instructors beginning to prepare for the upcoming Lean Academies in Summer 2004. The one-week Lean Academy™ offering is targeted at undergraduate students in conjunction with an industry experience, such as an internship or co-op assignment. The recent event for instructors was a train-the-trainer type event to present the pilot curriculum (offered June 2-6, 2003). Participants included faculty and staff from 12 different schools across the country as well as representatives of 4 different industry host sites. The instructors

completed the course and are in the process of revising the curriculum material over the course of the next several months. Site teams to support the upcoming Academy events were also identified.

25 Mar 04: LAI EdNet Lean Academy™ Coordination Meeting, Dana Point, CA

A coordination meeting was held on March 25th for 1/2 day following the annual LAI Plenary event. A small, but representative group of Lean Academy™ instructors and hosts meet with a few additional interested EdNet participants. This small working session focused on review host requirements as well as reviewing the status of each module revision. It was obvious from this session that good progress is being made on this project. Meeting notes were sent to the participants and the Lean Academy™ instructors who did not attend.

17 Apr 04: Lean SE EdNet Meeting, Los Angeles, CA

The Lean SE group of the LAI EdNet met on April 17th at Loyola Marymount University in Los Angeles, CA. The meeting was chaired by Professor Earll Murman of MIT, and participating universities included AF Center for SE at AFIT, LMU, MIT, Stanford, University of Missouri Rolla, and USC. The Lean SE group has been looking at the value of bringing together lean practices and systems engineering practices. The group has used the working title of "Lean SE" in efforts to date, and is now moving toward using the term "Value-based Systems Engineering" to describe this initiative. The universities presented highlights of their systems engineering curriculum and research. During the meeting, the group began work to develop a "Value-based Systems Engineering Framework" that will be similar to the Lean Enterprise Model (LEM).

7-18 Jun 04: Four LAI Lean Academies Offered Nationwide

LAI's EdNet has begun its summer LAI Lean Academy™ offerings in earnest, with no less than four separate ones taking place across the nation in the past two weeks alone. For the week of June 7-11, LAI Lean Academies were offered at St. Louis, MO in conjunction with the Boeing Company, and in El Segundo, CA, in collaboration with Northrop Grumman. The following week saw two more LAI Lean Academies, one in Huntington Beach, CA, under the auspices of Boeing; the other in Indianapolis with Rolls Royce. Each of these four LAI Lean Academies is profiled below.

An academic and industry instructor team delivered a LAI Lean Academy to 25 young Boeing St. Louis IDS employees the week of June 7. Highlights of the week included combination of lectures and active learning of lean enterprise knowledge; talks by Boeing IDS speakers Travis Durand, Vince Tappel, and Bill Carrier; factory tours of the F/A-18E/F and JDAM; a social night; and class presentations followed by graduation with Jim Young, Boeing IDS VP. Participants were from Flight and Lab Ops, Design and Manufacturing Engineering, Electronics Systems Engineering, Systems and Flight Engineering, and Finance Cost Estimation and Contracting. Instructors were Professors Earll Murman (MIT), Venkat Allada (University of Missouri/Rolla), Larry Boyer (St. Louis University/Parks College; Dick Lewis (Rolls Royce/Indianapolis (ret.)); and Jan Martinson, Liz Cange, and Ed Thoms from Boeing IDS.

An LAI Lean Academy also was held at Northrop Grumman Integrated Systems, El Segundo, CA, between June 7-11, by a team of MIT and Arizona State University professors and retired Boeing executives. In this intensive one- week course, the students were new employees with less than two's years average work experience. Lectures and tours of the F/A-18E/F composite structures plant and the final assembly of F/A-18E/F aft fuselages were combined with a comprehensive production simulation. Feedback from the Northrop employees and management indicate they were extremely pleased and would like to break new ground by conducting another LAI Lean Academy within six months' time.

Additionally, Rolls-Royce Indianapolis hosted their second LAI Lean Academy the week of June 14-18. 26 students, comprised of engineering and management interns, gave high marks to COO Steve Dwyer's opening remarks during Monday's kick-off luncheon. The impact of the LAI Lean Academy was evident as many of the participants from last year's inaugural LAI Lean Academy stopped by throughout the week, with many volunteering to participate in this year's events. The tour of Plant 5 on Monday afternoon provided first-hand evidence of lean benefits as the students toured "before" and "after" sections of the plant, along with a large section that was cleared for future use through implementing lean. A Tuesday luncheon lecture by Mike McKibbin described Rolls-Royce's "Process Excellence" efforts and helped drive home some of the metrics behind the previous afternoon's tour.

The LAI Lean Academy hosted by Boeing IDS in Huntington Beach, CA concluded June 18. Twenty-five energetic young new hires, primarily engineers, were introduced to lean concepts through presentations, simulation and active learning exercises, tours, and interviews. The week included presentations by local supporters of lean, a social activity, and final presentations from the students. This LAI Lean Academy focused on how to incorporate lean in a development and one-of-a-kind environment, reflecting the work done at the Huntington Beach site. Instructors included Alexis Stanke (MIT), Ted Mayeshiba (USC), Professor Bo Oppenheim (Loyola Marymount), and Stan Weiss (Lockheed Martin (ret.), Stanford), as well as Jan Martinson from Boeing IDS.

12-14 Aug 04: LAI Lean Academy™ Curriculum Development Workshop

This workshop, held August 12-14 at MIT, focused on revising the curriculum of the LAI Lean Academy™ course in preparation for future offerings in 2005. Ten Academy instructors and three host site representatives contributed to the working session. MIT Aeronautics and Astronautics Deputy Department Head Ian Waitz, and curriculum development specialist Dr. Diane Soderholm, presented to the group on how to incorporate active learning into teaching and how to develop appropriate learning objectives for course curriculum.

After reviewing feedback from the 2004 offerings, the group refined the course architecture, reallocating the time allocated to various modules based on lessons learned. They also revised the learning objectives for all modules, with a deeper dive into a few of the modules to revise specific content. The workshop was accompanied by time to network and socialize.

10-12 Nov 04: LAI EdNet Annual Meeting, St. Louis; Rolla, MO

30 participants attended the annual EdNet meeting, on November 10-12, hosted by Boeing IDS St. Louis and the University of Missouri at Rolla. 22 engineering and management educators representing ten US state and private universities, two government entities (DAU and AFIT), and the UK's University of Warwick, were joined by participants from three LAI Member companies and LAI staff. LAI Executive Board liaison JP Besong (Rockwell Collins) and Champions liaison George Reynolds (Northrop Grumman) contributed valuable input from the LAI membership. The overall meeting theme "Growing the Lean Enterprise Knowledge Network" was supported by the three-day agenda events.

3-7 Jan 05: LAI Lean Academy™ for Instructors, Embry-Riddle Aeronautical University, Daytona Beach, FL

Embry-Riddle Aeronautical University, in Daytona Beach, FL hosted an LAI Lean Academy™ for instructors, January 3-7. The academy previewed the updated Lean Academy™ curriculum for 2005 in front of an audience of colleagues and potential future instructors from 11 universities. Tours were provided by Lockheed Martin and Northrop Grumman so that participants could see lean in action and get a full feel for the progress of the academy's schedule. The revised curriculum was met with enthusiasm, and constructive feedback was collected for the final 2005 curriculum. The participants were universally eager to advance with Lean Academies™ or other LAI-mediated university/industry events.

14-18 Mar 05: LAI Lean Academy™ at University of Missouri at Rolla

6-10 Jun 05: LAI Lean Academy™ at St. Louis, MO

6-10 Jun 05: LAI Lean Academy™ at Indianapolis, IN

13-17 Jun 05: LAI Lean Academy™ at El Segundo, CA

13-17 Jun 05: LAI Lean Academy™ at Huntsville, AL

20-24 Jun 05: LAI Lean Academy™ at Huntington Beach, CA

June 2005 LAI Lean Academies™ Successfully Concluded

Approximately 153 students received certificates for week-long courses in the basics of enterprise lean. The courses were taught by a corps of 20 instructors, aided by several hosts, facilitators, speakers, tour guides, and sponsors. The LAI team sends congratulations to all students, and thank-yous to everyone who helped made the Academies possible.

This year's Academies offered a revised curriculum, including substantial improvements in lean engineering, quality and Six Sigma, and supply chain content, as well as an improved manufacturing simulation including a student-run supply chain. Several experiments were tried, including a "super academy" with almost double the number of students, more experienced audiences, increased local involvement in the content, and (in an earlier course) holding the Academy on a college campus. All were successful. The LAI Lean Academies also will have an extended season this year, with at least one more planned for this summer and several more in the fall and/or winter.

Preliminary analysis of student and instructor feedback indicates a continued very high level of user satisfaction. Critiques were constructive and will aid continuous improvement.

18-20 Jul 05: LAI EdNet Strategy Meetings, Redmond, WA

On July 18-20, the Microsoft Corporation, in Redmond, WA, hosted a meeting of the EdNet. The meeting involved two separate workshops for EdNet members to set future directions for lean education, EdNet and the LAI Lean Academy™.

The first EdNet workshop brought together approximately 25 participants including Microsoft, universities, government, and aerospace industry members. In addition to several key Microsoft participants, LAI Co-director and Professor Debbie Nightingale, MIT Professor Earll Murman, and EdNet sponsors J.P. Besong (of Rockwell Collins) and George Reynolds (of Northrop Grumman), participated in the discussions. The team recognized the importance of lean education and focused on creating a strategic plan for the future of EdNet.

Discussions regarding the future of EdNet included enhancements to the LAI Lean Academy™ (e.g., advanced modules, optional modules, restructured sequence); establishing an LAI Lean Academy™ Alumni Association; providing LAI Lean Certification; EdNet ongoing collaboration and communication; and EdNet virtual forums and online seminars.

7. LAI and MIT Collaborations

8 Apr 03: Space And Missile Systems Center LAI Briefing,

An LAI team briefed MG Craig R. Cooning, Vice Commander, Space and Missile Systems Center, Los Angeles Air Force Base, CA. MG Cooning is responsible for assisting the commander in the research, design, development and acquisition of space launch, command and control, and satellite systems. The briefing was held to familiarize MG Cooning and his staff with LAI, Lean Now and to provide recommendations for Space and Missiles Systems Center involvement in LAI and Lean Now. The Air Force Material Command was represented along with four industry members; Boeing, Lockheed Martin, Northrop-Grumman and Raytheon. The briefing consisted of four segments, LAI introduction, Lean Now overview, Global Hawk Lean Now successes, and recommended Space and Missile Systems projects. The briefing was well received and we established the lines of communication necessary to continue the dialog and develop a go forward plan to select several candidate projects for implementation of lean concepts within the Space and Missile Systems Center.

24 Apr 03: LAI Engagement With The Work Culture Transformation Board

LAI was invited to meet with the U.S. Air Force Work Culture Transformation Board sponsored by SAF/AQ during their meeting in Boston, MA to discuss lessons learned from large scale transformation efforts on April 24, 2003. Dr. Bill Kessler (Lockheed Martin and LAI Industry Co-Chair), Rusty Patterson (Raytheon), Jim Davis (Boeing) and Noel Nightingale (LAI Executive Director) participated in a three hour session imparting industry

lessons from transformation efforts. Debbie Nightingale (LAI Co-Director), presented LAI developed tools that would be useful in transformation efforts and Terry Bryan (LAI Stakeholder Co-Director), presented experience with the Lean Now projects. After the board meeting on April 25, 2003 Mr. Blaise Durante, Marty Evans, Jim Wolffe and Janet Hassan from SAF/AQ visited the LAI offices in Cambridge to receive additional information about LAI and the upcoming Executive Board Meeting. Mr. Blaise Durante, Deputy Assistant Secretary (Acquisition Integration), SAF/AQ, joins Gen Lester Lyles as the Government Co-Chair of LAI.

28 Sep 03: Book Co-Authored by Lean Aerospace Initiative Team Wins International Engineering Sciences Award

Lean Enterprise Value: Insights from MIT's Lean Aerospace Initiative (Palgrave, 2002) was recently awarded the 2003 "Engineering Sciences Book Award" by the International Academy of Astronautics (IAA). Professor Earll Murman, the book's lead author, received the award in a ceremony in Bremen, Germany on September 28, 2003. Professor Murman served as LAI's MIT director (1995-2002) and was Head of the Department of Aeronautics and Astronautics (1990-96).

The book was written by a team of MIT scholars affiliated with the Engineering Systems Division and its Center for Technology, Policy and Industrial Development, which is home to the Lean Aerospace Initiative. The co-authors were:

- Thomas J. Allen, Margaret MacVicar Faculty Fellow, Howard W. Johnson Professor of Management, Professor of Engineering Systems, and Co-Director, LFM and SDM Programs;
- Kirkor Bozdogan, CTPID Principal Research Associate;
- Joel Cutcher-Gershenfeld, Executive Director, Engineering Systems Learning Center and Senior Research Scientist, Sloan School of Management;
- Earll M. Murman, Ford Professor of Engineering and Professor of Aeronautics, Astronautics, and Engineering Systems;
- Deborah Nightingale, Professor of the Practice of Aeronautics and Astronautics and Engineering Systems;
- Eric Rebentisch, CTPID Research Associate;
- Tom Shields, CTPID Research Associate;
- Sheila Widnall, Institute Professor and Professor of Aeronautics, Astronautics, and Engineering Systems.

Other co-authors formerly affiliated with MIT are Hugh McManus, Fred Stahl, Myles Walton, Joyce Warmkessel, and Stanley Weiss.

19 Nov 04: MITRE/MIT Research Collaboration Workshop

On November 19, more than 75 people attended a workshop on research collaboration co-sponsored by MIT and MITRE. Participants included executives and leading researchers from MITRE, and faculty, researchers and PhD students from MIT. The MIT participants included 16 LAI-affiliated faculty, researchers, and students. The workshop was organized by LAI Principal Research Engineer and MIT Senior Lecturer in Engineering Systems Dr.

Donna H. Rhodes, and is the first in a series of planned events between MIT and MITRE designed to foster research collaboration.

13 Dec 04: MITRE/MIT Meeting

21 Jan 05: MIT/MITRE Workshop on Enterprise Architecting

LAI faculty, researchers, and graduate students participated in an MIT/MITRE mini-workshop on enterprise architecting on January 21. This workshop was the second in a series of planned events between MIT (including the LAI research group) and MITRE Corporation to foster research collaboration. The long-term objective is to perform joint research related to many aspects of engineering of complex systems, including the topic of enterprise architecting, one of the three major research thrusts in the current phase of LAI. Professor Debbie Nightingale presented the LAI research program to workshop participants. The participants exchanged information on research directions; identified and explored future research topics of mutual interest; and discussed strategies for collaborative research.

25 Feb 05: LAI Presents Systems Engineering Efforts to Japan Aerospace Exploration Agency

MIT Engineering Systems Division hosted seven visitors from the Japan Aerospace Exploration Agency (JAXA) on February 25th. The purpose of their visit was to gain understanding of research initiatives and education program related to systems engineering at MIT, including the LAI research group efforts. JAXA has a major reform initiative ongoing, including the enhancement of systems engineering. JAXA visitors presented an overview of JAXA and discussed their reform program. MIT Professor Daniel Hastings provided an introduction to the ESD program at MIT. LAI researcher Dr. Donna Rhodes discussed LAI support of the US DoD's systems engineering revitalization and provided an overview of research in systems engineering. After the visit, JAXA was able to celebrate its success in launching the H-IIA Launch Vehicle No. 7 (H-IIA F7) with the Multi-functional Transport Satellite-1 Replacement (MTSAT-1R) onboard.

4 Mar 05: MITRE/MIT Workshop on Complex Systems Engineering

LAI faculty, researchers, and graduate students participated in an MIT/MITRE Mini-Workshop on Complex Systems Engineering, held on March 4 at MITRE in Bedford, MA. This workshop was the third in a series of planned events between MIT (including the LAI research group) and MITRE Corporation to foster research collaboration. The long-term objective is to perform joint research related to many aspects of engineering of complex systems, including the topic of complex systems engineering, one of the of the three major research thrusts in the current phase of LAI. Professor Daniel Hastings introduced the MIT organization and strategic directions. LAI researcher Donna Rhodes highlighted LAI support to revitalization and systems engineering research initiatives at MIT. Three MIT-LAI doctoral students presented their research: Heidi Davidz, Adam Ross, and Jason Bartolomei. Several MITRE presentations highlighted research and advanced concepts in systems engineering. Many LAI affiliated faculty, LAI researchers, and LAI sponsored students participated in the workshop event. The participants exchanged information on research directions, identified and explored future research topics of mutual interest, and discussed strategies for collaborative research.

9 Mar 05: MIT/MITRE Workshop on Enterprise and Organizational Transformation

LAI faculty, researchers, and graduate students participated in an MIT/MITRE Mini-Workshop on Enterprise and Organizational Transformation, held on March 9 at MIT. This workshop was the fourth in a series of planned events between MIT (including the LAI research group) and MITRE Corporation to foster research collaboration, and focused on one of the of the three major research thrusts in the current phase of LAI. A panel session of leading experts from MITRE presented highlights of MITRE's research and initiatives. LAI Co-Director MIT Professor John Carroll and LAI researcher George Roth highlighted the LAI research and areas of interest. Participants included LAI affiliated faculty, LAI researchers, and LAI sponsored students. The workshop was a lively exchange on research topics of mutual interest and discussed strategies for collaborative research on several key research ideas.

8. International Collaborations

26-27 Jun 03: LAI-LARP Research Meeting

Representatives of the Lean Aerospace Initiative (LAI) research team at MIT (Tom Allen, Kirk Bozdogan, Debbie Nightingale, Eric Rebentisch) held a two-day meeting with their counterparts from the Lean Aircraft Research Program (LARP) at Linkoping University in Sweden to discuss potential collaborative research topics of mutual interest. The meeting was hosted by Ecole des Mines de Paris (ENSMP), already engaged in various collaborative research projects with LARP. The discussion resulted in an identification of three major areas for collaborative international research: alternative business models for lean enterprise value creation; knowledge creation and management in lean enterprise networks; and use of "demonstrators" for innovative and flexible product development. The group concluded that research on these three topical areas can be structured tightly to derive synergistic benefits. Also discussed was the topic of educational networks, to extend LAI's Educational Networks (EdNet) initiative internationally. This discussion was broadened to encompass the larger topic of transforming engineering education (e.g., through the infusion of lean thinking and lean systems engineering principles).

As the next step, the group decided to commence exploratory research on the three major research topics and to start consultations on the topic of transforming engineering education. A second step would be to convene a workshop (TBD) to share substantive findings, define more concrete collaborative research projects, and define collaborative initiatives to extend EdNet within the larger context of transforming engineering education.

The international collaborative research agreement between LAI and LARP is governed by a periodically-renewable Memorandum of Understanding (MOU), previously approved by the LAI Executive Board. A similar agreement is also in place with the UK-LAI, involving four universities in the United Kingdom (Bath, Cranfield, Nottingham, Warwick). These international research agreements stress the undertaking of collaborative research efforts by separate (not joint) teams, employing common analytical approaches. The resulting research

findings are shared at an aggregated level, in keeping with LAI's data confidentiality provisions. The research efforts do not entail any exchange of funding between the parties. Collaborative research projects are selected to provide maximum learning and implementation benefits to LAI stakeholders at relatively small incremental cost.

25 May 05: AMT and LAI Establish Lean Flight Initiative, Seattle, WA

During the Irish Presidential Trade Mission in Seattle, Washington, Aircraft Management Technologies (AMT) and the Lean Aerospace Initiative (LAI) announced a collaborative effort to engage industry, airline, and academic partners to establish the Lean Flight Initiative (LFI). The purpose of LFI will be to develop and promote lean principles, practices and tools among aircraft operators and companies involved in facilitating airline operations. Developing lean-based best practices for airline operations is a logical extension to the existing Lean Aerospace Initiative, allowing companies to utilize and extend best practices in use for aerospace manufacturing to benefit a broader audience. By pooling knowledge for the benefit of all members, new technologies can be implemented faster to allow aircraft operators and airline operations companies to more rapidly realize the benefits of improved operational performance, efficiency, and cost savings.

Lean methodology focuses on the elimination of waste and the efficient creation of enterprise value. Where lean principles have been introduced to date, enterprises have experienced dramatically improved competitiveness, productivity, and cost efficiency. The effective use of lean methods has been amply demonstrated in many different business environments, from manufacturing to back office processes and even medical care.

As a means of increasing efficiency and profitability in the fiercely competitive air transportation sector, LFI aims to extend the use of lean best practices to aircraft operators and companies that support airline operations such as providers of technology solutions, line maintenance and dispatch operations, documentation and content management, and other frontline processes. LFI aims to create an exceptional independent forum of airline, industry and academic partners.

“Using tools such as an LFI web portal, process re-engineering workshops and lean conferences, LFI would actively encourage members to share information and promote best practices in aircraft operations,” said Deborah Nightingale, professor at the Massachusetts Institute of Technology and co-director of the Lean Aerospace Initiative (LAI). “We see the Lean Flight Initiative as building on and expanding the expertise and experience that has been generated by initiatives such as the Lean Aerospace Initiative, and applying these principles to airline operations.”

“Several airlines, industry partners and academic institutions have already expressed a strong interest in this initiative,” said Steve Hardgrave, chief operating officer at AMT. “We continue to welcome the participation of all those within the aerospace industry who have an interest in increasing the productivity and cost efficiency of airline operations.”

9. LAI Conference Appearances

29 Jun - 3 Jul 03: LAI Participation In INCOSE 2003 Symposium

The International Council on Systems Engineering (INCOSE) annual international symposium was held June 29 - July 3rd. A number of LAI members participated in the conference. Those past and present LAI members from MIT faculty, research staff, and students (apologies to those overlooked) included:

- Professor Daniel Hastings, who was an invited participant in the charter meeting of INCOSE's newly formed Academic Council and accepted the position of Co-Chair for 2003-2004. He also briefed symposium attendees on the MIT Engineering Systems Division, as part of an invited Leadership Track.
- Professor Earl Murman chaired a meeting of a group that is beginning to look at Lean Systems Engineering.
- Stan Weiss was made an INCOSE Fellow and participated in the forming of the new Academic Council.
- As Director of Strategic Planning, a Fellow, and past president of INCOSE, LAI researcher Donna Rhodes participated in and presented at various INCOSE business and strategy meetings during the symposium, including the Lean systems engineering meeting.
- The symposium technical track included 5 papers authored by MIT's LAI affiliated researchers and faculty. LAI researcher Eric Rebentisch presented a paper with former LAI student Capt. Robb Wirthlin (USAF) on front-end requirements development processes. Tyson Browning, a former LAI student researcher, co-presented a tutorial on process modeling. David Stagney, recently graduated LAI student presented a paper on the organizational implications of real-time concurrent engineering. Incoming LAI student Katie Weiss won one of the very few best paper awards for her paper on reusable specification components for model-based SE.

8-12 September 03: SAE Aerospace Conference, Montreal, PQ

At the Aerospace Conference in Montreal (September 8-12, 2003) Kirk Bozdogan chaired a panel session (September 10) focusing on "Transforming Aerospace Supplier Networks." He framed the overall theme of the session by making the opening presentation ("Transforming Aerospace Supplier Networks: An Overview"). He outlined LAI's evolution and key implementation products, highlighted research on supplier integration, focused on the supplier transformation toolset being developed, and discussed future directions in lean supply chain management. Next speakers were Hamid Akhbari (USAF, C-17 System Program Office) and Julie Gissel (Boeing C-17 Program), who made a joint presentation ("Supply Chain Management: The Need for Speed"). In this presentation, they explained the evolution of the C-17 program, how the C-17 program enterprise is implementing LAI tools to transform the entire program enterprise, and within this larger context, how the program enterprise is developing and implementing key strategies for supplier integration to improve overall performance. The final speaker was Charles Ballard (Boeing, Integrated Defense Systems), whose talk was entitled "Transforming the Boeing Supplier Network." He discussed the imperative for supplier development and integration to effect greater efficiency gains, described Boeing's supplier transformation model and related supplier development

initiatives making use of the tools developed by LAI, shared some of the success stories, and summarized the benefits realized from these supplier development initiatives.

14-15 Apr 04: Conference on Systems Engineering Research (CSER2004), Los Angeles, CA

The 2nd Annual Conference on Systems Engineering Research (CSER2004) was held April 14-15 at USC in Los Angeles. The conference serves as a forum to identify challenges and research progress within systems engineering while providing decision makers and research leaders within government, industry and academia a forum for the exchange of ideas and concepts. The conference is co-sponsored by USC and Stevens Institute of Technology, with collaboration from INCOSE, NDIA, and IEEE. Earl Murman and Donna Rhodes, both of MIT, gave presentations in the plenary session. Eric Rebentisch of MIT presented a paper Lean Systems Engineering: Research Initiatives in Support of a New Paradigm, co-authored with Rhodes and Murman, on LAI research relevant to systems engineering, and the emerging ideas on the value of combining lean practices and systems engineering practices. Many members of the LAI SE EdNet group also presented at the conference, including Earl Murman (MIT), Donna Rhodes (MIT), Stan Settles (USC), Mark Wilson (AF SE Center at AFIT), and Cihan Dagli (UM Rolla).

23 Apr 03: Acquisition & Logistics Excellence Conference

LAI was represented at the Acquisition & Logistics Excellence Conference in Jacksonville, FL hosted by the Naval Air Systems Command Depot, Jacksonville. LAI presented a talk on Lean Enterprise Value complementing current efforts at NAVAIR Depot Jacksonville on lean transformation on April 23, 2003. The keynote presentations were by Mr. Frank Anderson of Defense Acquisition University and the Honorable E. C. "Pete" Aldridge, Under Secretary of Defense for Acquisition, Technology, and Logistics.

27 May 04: LAI Research Associate Presents to Naval Research Advisory Committee on Modular Mission Systems Technology and Principles

LAI researcher Dr. Eric Rebentisch made a second presentation to the Naval Research Advisory Committee (NRAC) Summer Study Panel on Science and Technology (S&T) for Modular Systems at the Office of Naval Research (ONR) on 27 May 2004. NRAC is the senior scientific advisory group to the Secretary of the Navy, the Chief of Naval Operations, the Commandant of the Marine Corps, and the Chief of Naval Research.

20-24 Jun 04: 14th INCOSE International Symposium

Representatives from LAI attended the 14th Annual International Symposium of the International Council on Systems Engineering (INCOSE) in Toulouse, France. LAI researchers led a well-received, key panel session on lean systems engineering. Information about LAI and its book, Lean Enterprise Value: Insights from MIT's Lean Aerospace Initiative, was on display at MIT's booth throughout the conference. Several individuals expressed interest in LAI and in purchasing the book. The conference also enabled student attendees to develop international and national relationships for valuable future research opportunities.

1-2 Sep 04: Air Force Conference on Advancing Systems Engineering, Dayton, OH

Dr. Marvin Sambur, Assistant Secretary of the Air Force for Acquisition, hosted this invited workshop. Executive briefings were given by Dr. Sambur; General Gregory Martin, Commander AFMC; and Dr. Glenn LaMartin, Under Secretary of Defense for AT&L. The workshop included an AF Program Executive Officer Panel; Award Winning Program Panel; JSF and F-22 Panel; Industry Experts Panel; SE Relationship with Test Panel; and Systems Engineering Experts Panel. Mr. Mark Wilson, Director of the AF Center for SE, hosted the workshop. The SE Experts Panel included LAI researcher Dr. Donna Rhodes, who discussed the recent AF/LAI Workshop on Systems Engineering for Robustness and follow-on initiatives. For more information, please contact Donna Rhodes at rhodes@mit.edu.

15-16 Sep 04: ICSE/INCOSE 2004 Conference, Las Vegas, NV

LAI researcher Donna Rhodes was the keynote speaker at the ICSE & INCOSE 2004 Conference, held 15-16 Sep in Las Vegas, NV. The conference theme was "Synergy between Systems Engineering and Project Management", and focused on realizing and applying the strengths of both systems engineering and project management as imperatives for success of challenging projects involving complex systems. Her presentation included a discussion of LAI's recent initiatives related to Systems Engineering. LAI PhD students Heidi Davidz and Troy Downen also presented technical papers at the conference, on their respective research, entitled *Enablers, Barriers and Precursors to Systems Thinking Development: The Urgent Need for More Information* and *A Mathematical Multi-Attribute Value Model for the Front-End Product Development Process*, respectively.

20-24 Sep 04: SAE Aerospace & Automated Fastening Conference & Exhibition, St. Louis, MO

The "Emerging Ideas and Practices in Supply Chain Management" panel session (September 22) was chaired by Kirk Bozdogan, with presentations from other members of the LAI community.

28-30 Sep 04: AIAA Space Conference 2004, San Diego, CA

The AIAA Space Conference was held Sep 28-30 in San Diego, CA. Professor Daniel Hastings of MIT chaired a panel session on Systems Engineering. LAI researcher Donna Rhodes was one of four panelists. Her remarks included a discussion of the ongoing LAI initiatives in Systems Engineering. The Conference also included representation from the LAI Educational Network (EdNet) as well as other LAI teams. On behalf of the EdNet, Professor Bo Oppenheim of Loyola Marymount University was present with a poster in the Education Alley of the display area.

29 Nov–01 Dec 04: Defense Manufacturing Conference, Washington, DC

Lean enterprise presentations were the featured technology session on 29 November and 1 December, from 1:30 to 5:00 PM, at the 2004 Defense Manufacturing Conference.

1 Feb 05: AIAA 1st Space Exploration Conference: Continuing the Voyage of Discovery, Orlando, FL

LAI Researcher Eric Rebentisch presented *Using Stakeholder Value Analysis to Build Exploration Sustainability* on February 1, 2005. an outgrowth of MIT's recent teaming with

the Draper Lab on a concept exploration and refinement study of how to best approach achieving the president's space vision of returning to the moon and going on to Mars.

While this activity is separate and distinct from LAI's on-going mission to improve the aerospace enterprise, there are parallels and potential benefits for LAI in the areas of stakeholder and value analysis, system architecting, enterprise architecting, and policy formulation. The paper, available on the LAI Web site, describes the on-going development of tools and methods that can be employed to use stakeholder values to design system and system of system architectures, enterprise designs, and policies. The promise of this work, underway through the summer, is the development of specific tools, methods, and guides that will be available to and support the missions of LAI's Product Lifecycle, Enterprise Architecture, and Enterprise Transformation knowledge communities.

24-25 Mar 05: 2005 Conference on Systems Engineering Research, Hoboken, NJ

The 2005 Conference on Systems Engineering Research (CSER) was held March 24-25 at Stevens Institute in Hoboken, NJ. LAI Principal Researcher Dr. Donna Rhodes participated in an executive forum on institutionalizing systems engineering, and also presented a paper on a new doctoral research network sponsored by the International Council on Systems Engineering (INCOSE). Three LAI affiliated doctoral students, Adam Ross, Heidi Davidz, and Jason Bartolomei, also participated in the conference. Davidz presented her paper, *Enablers and Barriers to Systems Thinking Development: Results of a Qualitative and Quantitative Study*, for which she was awarded best student presentation as judged by her peer researchers in an award sponsored by the Center for Systems Management. ESD doctoral student Jason Bartolomei also presented his paper, *Dynamic Utility in Systems Architecting*.

14-18 May 2005: IIE Annual Conference, Atlanta, GA

William H. Swanson, chairman and CEO of consortium member Raytheon Co., received the inaugural Captain of Industry Award on 15 May, at the IIE Annual Conference. Swanson accepted the award "on behalf of the 80,000 people of Raytheon who have given me the opportunity to do what I love doing."

The award honors those who have achieved leadership positions in business, industry, or government. Its purpose is to credit industrial engineering graduates who have and continue to demonstrate leadership in a national or international context and identify the IE profession as a key reason for their success. Swanson, who joined Raytheon in 1972, has been company president, executive vice president, and president of electronic systems, and general manager of various Raytheon divisions.

10-14 Jul 05: INCOSE Symposium, Rochester, NY

LAI had substantial participation in this year's event. Professor Daniel Hastings, MIT's ESD Director and Professor of Aeronautics and Astronautics and Engineering Systems, chaired the meetings of the INCOSE Academic Council, which provides policy level guidance to the INCOSE Board of Directors, and the MIT ESD exhibit booth highlighted the doctoral work of three LAI students: Heidi Davidz, Adam Ross, and Jason Bartolomei.

During the symposium, several members of the LAI at MIT community presented papers. These included *Calculations of Flexibility in Space Systems* (D. Hastings, R. Nilchiani, and C. Joppin), *A Framework for Understanding Uncertainty and its Mitigation and Exploitation in Complex Systems* (H.L. McManus and D. Hastings), *The Tradespace Exploration Paradigm* (A. Ross and D. Hastings), and *Accelerating the Development of Senior Systems Engineers* (H. Davidz, D. Nightingale, and D. Rhodes).

Additionally, LAI researcher Dr. Donna Rhodes recently received the prestigious INCOSE Founders Award, for her 15 years of distinguished contributions to INCOSE, including serving as its Technical Board Chair, Fellow, Director of Strategic Planning and President.

10. Staff Appointments

Jul 03: Donna Rhodes joins LAI

Donna Rhodes joins LAI as a Research Associate, focusing on the principles and practices for enterprise transformation and enterprise architecturing needed to address the organizational and systems challenges of the 21st century, as well as teaching in the MIT Engineering Systems Division. Donna's educational background is in systems theory and systems engineering.

Donna has spent most of her career at IBM Federal Systems/Lockheed Martin Federal Systems (LMFS) in Owego, New York focusing on aerospace systems and engineering excellence. She was the Systems Engineering Process Owner, managing the engineering center-of-competence, which established and consulted on engineering best practices and technologies. She was also a member of the team awarded the 1998 Lockheed Martin NOVA Award for contributions leading to LMFS Owego's attainment of the Software Engineering Institute's highest rating of Capability Maturity Level 5. Prior to coming to MIT, Donna also served as Director of Process Engineering for Lucent Technologies Software Products Group, addressing the increasing enterprise and systems challenges in commercial product development.

Donna has also had a leadership role in the formation of the International Council on Systems Engineering (INCOSE), and is a former INCOSE President. She is presently the INCOSE Director for Strategic Planning, an INCOSE Fellow and serves on the Board of Directors. She is also an Associate Editor at Systems Engineering, INCOSE's journal. Donna has published numerous papers in the field of systems, co-authored industry and company standards and guidebooks, and has been an invited speaker and panelist for industry, government, university, and company events.

Donna may be reached at rhodes@mit.edu.

Jul 03: George Roth joins LAI

George Roth joins LAI as a Research Associate, specializing in organizations/people research. He has an extensive background in organizational learning and management. Previously, George has held the positions of Executive Director of the Ford-MIT Alliance -

an alliance emphasizing learning and knowledge creation activities in engineering research, education and environmental policy and Research Director for the MIT Center for Organizational Learning - a consortium of companies applying systems thinking and learning skills to improve corporations and their people.

George is also the chair-elect of the Organizational and Change Division of the Academy of Management. He is the author of numerous academic and professional journal articles on learning and change; including articles in the Harvard Business Review, Organizational Dynamics and AQP Journal describing new approaches to diffusing learning across organizations. Other writing about companies' experiences in developing, sustaining, and transforming learning are in his co-authored books: *The Dance of Change: The Challenges to Sustain Momentum in Learning Organizations* (Doubleday/Currency), *To the Desert and Back: The story of one of the most dramatic business transformations on record* (Jossey-Bass), *Car Launch: Managing the Human Side of Change* and *Oil Change: Perspectives on Corporate Transformation* (both with Oxford University Press).

George may be reached at groth@mit.edu.

LAI Stakeholder Co-Director Terry Bryan Returns to Raytheon

Terry Bryan, appointed LAI Industry Stakeholder Co-Director in September 2002, returned to Raytheon in January 2005. LAI is grateful for Raytheon's donation of Terry to fulfill the critically important lean implementation leadership role for LAI. Although titled Stakeholder Co-Director, Terry quickly became LAI's super program manager for implementation activities using lean concepts, member expertise and LAI tools to accomplish this very important and valuable contribution. Terry led the Lean Now initiative as the Lean Now lead change agent. He managed a highly successful campaign featuring a comprehensive strategy, related tools, training, and resources for deployment of lean concepts on processes which touched both government and industry.

Terry's responsibilities included facilitating several one- and multi-day workshops, a 40-hour training course, practitioner training, and other major projects within Lean Now Wave One and Two projects such as F/A-22, F-16, Global Hawk, and Arnold Engineering Development Center. Many of these projects have spawned countless additional improvement activities based on the seed corn sown by Terry and his team. He was also the leader of new efforts in enterprise transformation at the Ogden and Oklahoma City Air Logistics Centers. This was new and exciting territory for LAI and Terry provided the critical coordination and leadership to pull it off.

Terry also was consistently one of LAI's best spokespersons. He played a valuable role in growing LAI and being its strong advocate. His traveling to support Lean Now, enterprise transformation activities and general awareness of LAI is legendary.

"Terry's role was multi-faceted and helped extend our interface with the entire LAI enterprise," said Professor Debbie Nightingale, LAI Co-Director from MIT's School of Engineering. "We looked to Terry to actively engage our members in collaborative efforts, learning forums, and in the development and use of transformation tools. Given his

background as end-user, engineer, and program manager, we knew that Terry would bring multiple perspectives, first-hand knowledge, and another level of peer understanding to LAI."

Aug 03: LAI Welcomes Geoff Groesbeck as Communications Manager

The Lean Aerospace Initiative (LAI) at M.I.T. is pleased to announce a new addition to its staff.

Geoff Groesbeck joins LAI as Communications and Marketing Manager, where he will focus on strategic communications designed to enhance LAI's visibility and applicability across a wide spectrum of audiences. Geoff's educational background is in international communications and linguistics.

Geoff's professional background has been primarily in building and implementing corporate and non-profit communications infrastructures for multinationals and NGOs. His sector expertise is in international finance and technology, with extensive work in Asian and Latin American business development.

Geoff may be reached at gapg@mit.edu.

Sep 03: LAI Thanks Co-director Tom Allen and Welcomes his Replacement John Carroll

Critical to the integration of Management and Engineering disciplines into the Lean Aerospace Initiative (LAI), Professor Tom Allen was MIT's Sloan School of Management Co-Director from early in the initiative. Specializing in organizational psychology and management, Tom explored the relationship between organizational structure and behavior, the role of technological gatekeepers in technology transfer, and how a building's layout influences communication. Tom has also been a source for stories on international technology transfer, reward systems for technical professionals, and how organizational structure affects project performance. The principal focus of his long-term research is project management in the pharmaceutical and aerospace industries. Tom's guidance to the LAI staff, students faculty and the consortium has been instrumental in the success of LAI. Tom leaves the Lean Aerospace Initiative to become the co-director of the Leaders for Manufacturing (LFM) and System Design and Management (SDM) programs.

Replacing Tom as LAI Co-Director is John S. Carroll, Professor of Behavioral and Policy Sciences at the Massachusetts Institute of Technology Sloan School of Management. John received a B.S. in Physics from MIT and a Ph.D. in Social Psychology from Harvard. He has taught in the Psychology Departments of Carnegie-Mellon University and Loyola University of Chicago and was a Visiting Associate Professor at the University of Chicago Graduate School of Business prior to joining the Sloan School faculty in 1983. John has published four books and numerous articles in several areas of social and organizational psychology. Much of his research has focused on individual and group decision-making, the relationship between cognition and behavior in organizational contexts, and the processes that link individual, group, and organizational learning. John is also a Fellow of the American Psychological Society.

John teaches the Team Project course in the MIT Sloan Master's program that requires students to identify and analyze ongoing change initiatives in organizations through interviews, observation, and document search. He also teaches leadership, teams, and decision making in a variety of programs including executive education.

LAI Welcomes Jennifer Hartwell to Research Staff Position

LAI is pleased to announce the appointment of Dr. Jennifer K. Hartwell to its research staff. Jennifer will be working half-time for the next year on the enterprise change research efforts, starting with research at Ogden ALC and its EVSMA and lean transformation efforts. She is a recent graduate of the Boston College Ph.D. program in Organizational Studies. Last year she served as a Post Doctoral Research Fellow at the Kravis Leadership Institute at Claremont McKenna College. Her recent research focuses on organizational change and careers. Specifically, she has been examining effective leadership practices for implementing alternative work arrangements for professionals. She holds an MS in Industrial Environmental Management from Yale University and a BS in Environmental Studies from the University of Vermont.

LAI Welcomes Chet Labedz to Research Staff Position

LAI is pleased to announce the appointment of Chester S. Labedz, Jr. to its research staff. Chet will be working half-time for the next year on enterprise change research efforts, starting with research at Tinker ALC and its EVSMA and lean transformation efforts. He is in his final year of the Boston College Ph.D. program in Organizational Studies. Prior to his recent studies, Chet worked for Textron for 15 years in human resources management. He holds a JD from the University of Michigan and an AB in Mathematics and Philosophy from Boston College. His principal research interests are in the dynamics of organizational transformation and human resource strategic management.

LAI Educational Manager Named

Ms. Jacqueline P. Candido, an MIT research affiliate, has been named to lead the educational programs for the Lean Aerospace Initiative, including EdNet and the LAI Lean Academy™.

Ms. Candido spent more than sixteen years with Hewlett Packard (1983-1999) in various positions including systems engineer, technical consultant, learning technology specialist, and education program manager. She has managed complex global programs including instructional design and delivery in the US, Europe and Asia, and has created educational curriculum for industry, government and academic settings, using a variety of technology, including online distance education. Ms. Candido has extensive experience facilitating dozens of courses on a variety of topics. In addition to several consulting projects, she also worked for Gartner as a director of sales training programs and at Millersville University as assistant director of distance learning.

Ms. Candido is a Ph.D. candidate at Drexel University in Philadelphia, in the program of Educational Leadership and Learning Technology, and holds a BS degree in Information Systems and an MS degree in Education, both from St. Joseph's University in Philadelphia.

Appendix B: LAI Membership during the Phase

Government Consortium Members

- Air Force Aeronautical Systems Center
- Air Force Electronics Systems Sector
- Air Force Materiel Command
- Air Force Research Laboratory, MANTECH
- Air Force Space and Missile Center (SMC)
- C-17 System Program Office
- Defense Contract Management Agency (DCMA)
- Defense Finance and Accounting Service (DFAS)
- F-22 Systems Program Office
- National Aeronautics and Space Administration (NASA), Office of Safety and Mission Assurance
- Secretary of the Air Force, Office of the Assistant Secretary for Acquisition
- U.S. Army, Aviation and Missile Command (AMCOM)
- U.S. Department of Defense, Office of the Under Secretary for Acquisition, Technology & Logistics
- U.S. Navy, Naval Air System Command (NAVAIR)

Industry Consortium Members

- Aerojet-General
- Aerospace Testing Alliance
- Bell Helicopter
- Boeing Commercial Airplanes
- Boeing Integrated Defense Systems
- Boeing Phantom Works
- BAE SYSTEMS North America
- Curtiss-Wright Controls, Inc.
- Harris Corporation Government Communications Systems Division
- L-3 Communications Integrated Systems
- Lockheed Martin Aeronautics Company
- Lockheed Martin Space Systems Company
- Lockheed Martin Electronic Systems Business Area
- Northrop Grumman Integrated Systems
- Northrop Grumman Electronic Systems
- Northrop Grumman Mission Systems
- Northrop Grumman Space Technology
- Raytheon Aircraft Company
- Raytheon Company

- Raytheon RMS, NCS, SAS; Mr. Keith Weiss
 - Raytheon Missile Systems (RMS)
 - Network Centric Systems (NCS)
 - Space and Airborne Systems (SAS)
- Rockwell Collins Inc.
- Rolls Royce North America
- Textron Systems Corp.
- United Defense LP
- United Technologies Corp. including:
 - Pratt & Whitney Military Engines
 - Hamilton Sundstrand
 - Sikorsky Aircraft

Collaborating Universities:

Massachusetts Institute of Technology (MIT)

With collaboration from:

- UK LAI (The Universities of Warwick, Bath, Cranfield, and Nottingham)
- Lean Aerospace Research Program (Linköping University)

Other Invited Partners:

- Aerospace Industries Association (AIA)
- Defense Acquisition University (DAU)
- Institute for Defense Analyses (IDA)
- International Association of Machinists (IAMAW)

LAI Educational Network

- Air Force Institute of Technology
- California Polytechnic State University
- Cranfield University
- Defense Acquisition University
- Embry Riddle Aeronautical University
- Georgia Institute of Technology
- Hampton University
- Loyola Marymount University
- Massachusetts Institute of Technology
- Old Dominion University
- Purdue University
- St. Louis University
- University of Alabama – Huntsville
- University of Bath
- University of Iowa

- University of Louisiana, Lafayette
- University of Michigan
- University of Missouri - Rolla
- University of New Orleans
- University of Southern California
- University of Tennessee
- University of Texas – Arlington
- University of Warwick
- Wichita State University
- Worcester Polytechnic Institute
- Wright State

Appendix C: LAI Associated Faculty, Researchers and Contributors

Faculty

Professor Tom Allen
Professor John Carroll
Professor Dan Hastings
Professor Earll Murman
Professor of Practice Deborah Nightingale
Professor Warren Seering
Institute Professor Sheila Widnall

Researchers

Principal Research Associate Kirkor Bozdogan
Research Associate Eric Rebentisch
Principal Research Associate Donna Rhodes
Principal Research Associate George Roth
Research Associate J. Tom Shields
Research Associate Jayakanth Srinivasan
Research Associate Alexis Stanke

Research Assistants

Christoph Bauch
Henrik Bresman
Jessica Cohen
Lt. Col. Rob Dare
Maj Dennis Deitner
Jason Derleth
Troy Downen
Bobak Ferdowsi
Gregoire Ferre
Martin Graebisch
Cory Hallam
Justin Hemann
Erisa Hines
Maj. Ron Jobo
Sandra Kassin-Deardorf
Bing Liu
Vikram Mahidhar
Josef Oehman

Adam Ross
Nirav Shah
1Lt Tim Spaulding
Dave Stagney
Alexis Stanke
Ryan Whitaker

Contributors

Geoffrey Bentley
Terry Bryan
Hugh McManus
Noel Nightingale
Fred Stahl

Support

Cathy Chase
Geoffrey Groesbeck
Allie Lopez
Juliet Perdichizzi
Deneen Silvano

Other Researchers*

Betty Barrett
Lydia Fraile,
Joel Cutcher-Gershenfeld
Adam Litwin

Other Students*

Daniel J. Allison
Derek W. Beck
Michael M. Brylawski
Gregory David Dibb
Yuliya M. Frenkel
Ignacio Grossi
Mark Hagan
Thomas C. Hutton
Jin Kato
Satish Krishnan
Blaine Paxton
Patricia Proven

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Stanley J. Prutz
Christopher James Roberts
Thomas A. Seitz
Jeremy P. Tondreault
Eric A. White
Michael R. Wright